FOREIGN BROADCAST INFORMATION SERVICE

JPRS Report

Science & Technology

Japan

JPRS-JST-87-029

27 October 1987

SCIENCE & TECHNOLOGY

JAPAN

CONTENTS

/9986

DEVELOPMENTS IN CERAMIC SUPERCONDUCTING MATERIALS

Energy Gap

Tokyo NIKKO MATERIALS in Japanese Jul 87 p 12

[Text] On the 9th a research team headed by Professor Eizo Yamaka of the Material Engineering Department of Tsukuba University succeeded in measuring the energy gap of a ceramic superconducting material, around which a development boom has been created.

In an ordinary conductor, each electron behaves independently of the others. However in a superconductor, two electrons stick to each other forming an electron-pair.

As soon as the electron-pairs break apart the substance loses superconductivity and turns into an ordinary conductor. The energy gap is a parameter that tells how far apart the energy levels of the paired electrons and single electrons are. In other words it describes the amount of energy required to break up the electron-pair. As the gap widens, the critical temperature--temperature at which superconductivity sets in--increases.

The material used for measurement was a ceramic oxide of yttrium, barium and copper. The researchers coated this superconductor with an insulator film of approximately 10 angstrom (one angstrom is equal to a billionth of a centimeter). Thin-film electrodes made of lead were then attached to the insulator film. By running current between the superconductor and the lead electrodes the researchers took measurements on the current-voltage characteristics. The result reveals that a very large energy gap--ten or more times as large as the gap of a conventional superconductor--exists with the maximum found at 60 mm eV.

Oxide Superconductors

Tokyo CERAMICS JAPAN in Japanese Jul 87 pp 608-611

[Text] The international race to develop oxide superconductors for high temperatures that began in December 1986 was initiated by the result of the research conducted by a team led by Shoji Tanaka. Their research started out as a specially designated project, namely "New Superconducting Materials" which

was carried out from 1985 to 1986. The fast-paced development that took place in the following one-month period produced results which otherwise could have been achieved only after a full year of normally paced effort. Therefore, it is generally observed that the year 1987 marks an extremely important cornerstone. In recognition of the timing the Ministry of Education formed a small select research section. The Ministry wants to establish Japan's superiority by orchestrating a close exchange and cooperation between the Material Search Group for Superconductors and the Basic Physical Properties Group. Specifically the research project--funded with 1.69 billion yen--seeks to investigate two problems:

(1) To search for high transition-temperature substances, and especially to study the cause of the resistance anomaly near 240K in Y-Ba[2]-Cu[3]-O[9-delta] oxides that many researchers have reported;

(2) To explain the mechanism responsible for the substance's superconductivity while contrasting the finding with that of a 40K superconductor La[2-x]A[x]Cu-O[4]. This research will involve the preparation of high-quality Y-Ba-Cu-O powder, the creation of the mono-crystal, the determination of the structure (especially on the oxygen deficiency), a phase-diagram analysis (on the competition with other order-phases) and measurements of the physical properties (especially the NMR-caused antistropic gap).

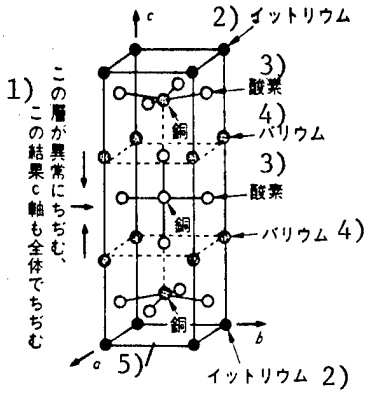
Sadao Nakagima	Professor, Physics Dept., Tokai University	General Coordination
Shoji Tanaka	Professor, Engineering, Tokyo University	General coordination and communication on research activities
Kazuo Fueki	Professor, Engineering, Tokyo University	
Nadao Iguchi	Director, Molecular Science Lab., National Joint Research Organization, Okazaki	
Yasuo Endo	Professor, Physics, Tohoku University	
Hidetoshi Fukuyama	Professor, the Institute for Solid State Physics, Tokyo University	Manager of Group for investigation & research on electron structure & superconduction mechanism

Hirokazu Kitazawa	Associate Professor, Tokyo University	Search & Development of high-temperature oxide superconductors, & investigation of basic properties
Fumihiko Takei	Professor, the Institute for Solid State Physics, Tokyo University	
Masayasu Ishikawa	Associate Professor, the Institute for Solid State Physics, Tokyo University	
Tadatoshi Sato	Associate Professor, Molecular Science Lab., National Joint Research Organization, Okazaki	
Seichi Kagoshima	Associate Professor, Liberal Arts & Science, Tokyo University	Structure & magnetization of high-temperature oxide superconductors
Shinobu Mizukami	Associate Professor, Liberal Arts & Science, Tokyo University	
Yoshio Takefuji	Professor, Metal Research Lab., Tohoku University	Electrical & magnetic characteristics of high-temperature oxide superconductors
Kuniho Asayama	Professor, Basic Engineering, Osaka University	
Toshizo Fujita	Professor, Physics, Hiroshima University	

Structure of Oxide Superconductor Predicted

A joint research group headed by Chief Research Officer Fujio Okamura of the National Institute for Research in Inorganic Materials of the Science and Technology Agency and Associate Professor Shigeho Sueno of Tsukuba University is working on a model structure for the Y-Ba-Cu oxide ceramic. According to recent findings concerning the structure prediction, a portion along a-axis, the long axis, undergoes abnormal shrinkage. Further, the length in the direction of c-axis was determined to be 11.67 angstrom. However, no such crystals have yet been prepared. The researchers believe that by pushing the research in the direction of attaining this value, they can create a new substance that becomes superconductive at a still higher temperature.

Although the family of Y-Ba-Cu oxides possess the best known characteristics for a superconducting material, the situation regarding the making of a model structure is still chaotic. Scientists from the joint group have been studying published papers, and they concluded that all seven models proposed by AT&T's Bell Laboratory in the U.S. and Argonne National Laboratory in the U.S. are correct, and that the difference with respect to the structure is due to the variation in the oxygen content ratio which causes a continuous structural change. After the in-depth review of the findings on the inter-dependence between this continuous structural change and the change in electrical conductivity, the group concluded that the material created at Argonne Laboratory possesses a structure most resembling the ultimate structure.



Key:

1) As this layer shrinks abnormally, the overall height along the c-axis shrinks as well.
2) Yttrium
3) oxygen
4) Barium
5) Copper

Sumitomo Electric Industry/32KA Superconducting Polycrystal Ceramic Thin-Film

Sumitomo Electric Industry announced on June 1 that its researchers successfully developed a superconducting thin-film made of an Y-Ba-Cu-O ceramic material which has recorded a critical current density of 32 kilo-A per square centimeter at 77K and 200 kilo-A per square centimeter at 20K. The critical temperature of the material is 85K. For commercial application, a superconductive material must have a high critical current density: 100 kilo-A per square centimeter for use as a magnet or 10 kilo-A per square centimeter for use as a supercomputer logic element. At Sumitomo, researchers used the sputtering method to create the thin-film. The technique enabled them to grow a polycrystal thin-film on a substrate with the crystal axes aligned in a single direction. While the thin-film developed by IBM of the U.S. achieves a critical temperature of 100 kilo-A per square centimeter at 77K, according to Sumitomo, its production technique for creating polycrystal thin-films would leave a broader choice of materials for the substrate and it would make it easier to produce a much larger superconductor film.

Sumitomo researchers have determined that the disadvantage of a thin-film is its tendency to become amorphous easily, thus degrading its characteristics. Recognizing the fact that the current flows more readily in the a- and b-axes rather than c-axis, they sought to place a- and b-axes in parallel to the substrate face and at the same time re-arrange each crystal. These efforts led to the recent success in the creation of a thin film with high degrees of reproducibility and stability. The thin-film growth speed measured on a 3 by 2 centimeter substrate was 30 to 90 seconds. This technique leaves the door open for the possibility of growing a film on a substrate with a larger area, and since it grows a thin film of a polycrystal kind, substrate materials are available for selection.

R&D Continues For Superconducting Ceramics

Sumitomo Heavy Machine Industry has developed a ceramic material of an Y-Ba-Cu oxide that exhibits the superconductivity property of zero resistance at a temperature of 96K. Last February the company formed a development team at its Hiratsuka Research Laboratory in Kanagawa Prefecture where research work had been centered around superconductors. The team developed a ceramic that becomes superconductive at 90K in early April. Following this they modified the firing technique and came up with one for 96K in May. With the aim of developing applications, they will conduct studies on superconducting ceramic materials formed into wires and will investigate the possibility of improving the current density characteristics, a crucial factor for a viable application.

Kawasaki Steel has developed a Y-Ba-Cu-O ceramic superconducting material and has succeeded in producing superconducting wires 1 mm in diameter and 10 meters in length. The substance starts loosing electrical resistance at 95K and becomes thoroughly superconductive at 93K. Kawasaki researchers verified by X-ray diffraction that its crystals are completely single-phased. Thanks to the single-phase property, the researchers have overcome the biggest obstacle to commercial application--raising the critical current density. They achieved 410 amps per square centimeter. Kawasaki's technique makes it possible to manufacture homogenious materials on an industrial scale.

Sumitomo Heavy Machine Industry announced its development and marketing of a measuring instrument for accurate detection of critical temperature of high-temperature superconducting materials. The instrument comes with a small helium refrigerator and vacuum compressor. It allows easy measurement of superconduction characteristics such as electrical resistance and magnetic histerisis while the temperature of the sample is varied. The range of measurable temperatures is -263 to 27 degrees celsius. Since the He refrigerator is of a closed-cycle system whereby the helium is completely contained in a gaseious form, there is no need to refill the liquid helium or liquid nitrogen for refrigeration. A complete unit costs 5,500,000 yen. Sumitomo is projecting yearly sales of 60 units.

Professor Osamu Nishikawa of Tokyo Institute of Technology has reported that according to the data he obtained there is a wide compositional variation in even a single crystal of a high-temperature superconducting material. The instrument that the professor and his assistants used in studying the composition is called an atom probe, made of an ionization microscope and a mass spectroscopy. The sample formed into a pot shape was vaporized, one single-atom layer after another, beginning with the outermost layer. The vaporized ionized atoms and molecules were then detected and measured by the detector. By analyzing the charge-to-mass ratio of the ions, the scientists identified which atoms constitute the superconductor. The tested samples were prepared by mixing raw ingredients of yttrium oxide, barium carbonate and copper oxide, and firing the mixture at 900 degrees celsius twice, each time for five hours. The samples become superconductive at 90K or less. The measurement result shows that the material is made of some regions that contain mostly ions of Ba and a few ions of Cu, and other regions of the opposite composition. Also as time passed while measurements were being taken on the same sample, the ion distribution varied.

According to Professor Nishikawa, understanding the relationship between the compositional variation and the conditions of the production processing would improve the production technique and would give a clue as to development of a room-temperature superconducting material.

13346/9738
CSO: 4306/7106

EXPERIMENTAL TECHNICAL SATELLITE LAUNCH SET FOR 20 AUGUST

OW180823 Tokyo KYODO in English 0711 GMT 18 Aug 87

[Text] Tanegashima, Kagoshima Pref, 18 Aug (KYODO)--If all goes well, on Thursday an H-1 rocket of the National Space Development Agency of Japan (NASDA) will lift off from the island of Tanegashima south of Kyushu to begin a mission that will push Japan one step closer to space independence while allowing for a giant leap forward in mobile satellite communications.

The three-stage H-1 rocket, which is scheduled to lift off at 5:50 p.m. JST, will test new technology that will allow Japan to place fairly large satellites into geostationary orbit as it launches the experimental technical satellite type 5 (ETS-V), a communications and positioning system for aircraft and small ships.

The key to the success of the second H-1 launch hinges on a newly developed Japanese "Apogee motor" attached to the bottom of the ETS-V satellite, which is expected to give the satellite a final push to its perch 35,900 kilometers above the equator slightly to the southeast of Japan.

In addition, the second launch of the H-1 will be used to test a new Japanese-developed solid-fuel third stage, which was not included in the first launch of the H-1 last 13 August.

The rocket for that launch consisted of only two stages and was intended to test an inertial guidance system and a powerful liquid oxygen/liquid hydrogen second-stage engine called the LE-5, which were both independently developed by Japan.

The H-1 rocket was developed by NASDA as a replacement for its N-I and N-II rockets, which were only capable of lifting payloads of 150 and 350 kilograms, respectively, into geostationary orbit.

The feeble lift capabilities of these two older rockets stemmed from their being handicapped with low-powered upper stages that were unable to push all but the smallest of satellites into highly useful geostationary orbits.

Another problem with the N-I and N-II rockets was that they heavily depended on U.S. technology which gave the U.S. a veto right over their commercial applications. In addition to a first stage and booster rockets based on the U.S.'s delta rocket, the N-I and N-II used a U.S.-designed inertial guidance system to follow their flight path to orbit.

Although the H-1 still uses the same first stage and strap-on booster rockets as the N-II, just about everything else in the 140-ton, 40 meter tall rocket is home grown. The most impressive piece of this new Japanese technology is the powerful second stage LE-5 engine, which produces 10.5 tons of thrust and has a restart capability in outer space.

When combined with the new solid-fuel third stage and apogee engine, the LE-5 gives the H-1 the ability to lift a payload of 550 kilograms up into geo-stationary orbit, which roughly translates into a 60 percent increase in payload over the N-II.

The ETS-V communications satellite that the H-1 will lift into orbit will serve as a test bed for a new type of mobile communications system that will eventually replace short wave communications, which is subject to interference at times because of unstable conditions in the ionosphere.

Both the Electronic Navigation Research Institute (ENRI) of the Ministry of Transportation and the Radio Research Laboratory (RRL) of the Ministry of Posts and Telecommunications will use the ETS-V to carry out experiments such as controlling aircraft traffic over the Pacific ocean, and providing navigational assistance for smaller ships on the surface of the ocean.

However, the most novel experiment will be to test a small portable transceiver about the size of an attache case. This device could become the forerunner of even smaller hand-held transceivers that could be used for transmitting data from remote locations, creating a future communications industry to rival the budding mobile telephone industry.

The ETS-V is equipped with a two-beam antenna that uses different frequencies for transmitting and receiving and is powered by two solar array paddles fitted with 10,400 solar cells. Communications with aircraft will be carried out using the l-band and c-band, while the s-band will be used for telemetry, tracking, and the command subsystem.

NASDA plans to use the H-1 rocket for six more launches, after which it will be replaced by the still more powerful H-II rocket. That rocket, scheduled for deployment around 1992, will be able to lift 2,000 kilograms into geo-stationary orbit, and will be made entirely from Japanese-developed technology, making commercial launches possible for the first time.

Although the Japanese space program is still very modest compared to those of the U.S. and Europe, it has been scoring successes at a time when the U.S. and European space programs have come to a halt due to launch failures. This will allow the Japanese space program to narrow the distance with its competitors.

This situation has already caused some western analysts to sound warnings that the Japanese are poised to capture the satellite communications market the way they have captured so many other markets. And with the appreciation of the yen and trade protectionism pushing Japan out of its traditional markets, they are probably warnings worth noting.

/9738
CSO: 4307/035

PROGRESS ON ELECTRONIC DICTIONARY PROJECT REPORTED

Tokyo KOGYO GIJUTSU in Japanese Feb 87 pp 19-21

[Article by Hiroshi Uchida]

[Text] 1. History of Electronic Dictionary R&D

Electronic dictionary R&D is one of the cornerstones of the development of natural language processing technology, constituting a cultural heritage of 20'th-century mankind which should be bequeathed to the next generation. The development of electronic dictionaries requires the input of knowledge and skills from a wide range of fields that include computer science, linguistics, and lexicology. When one considers the numbers of specialists involved in these fields, the scale of the dictionary which will form the foundation, and the quality of work demanded, the near impossibility of pursuing the development through a single corporate entity is quickly appreciated.

Starting with this situation, and with the support of the Key Technology Center (a specially recognized corporation) and the cooperation of private industry, Japanese Electronic Dictionary Research, Ltd (EDR) was formed on April 26, 1986, charged with beginning joint development work on a large-scale general-purpose electronic dictionary to serve as a foundation for implementing natural-language processing in the future.

EDR is financially backed by the Key Technology Center and eight private corporations (Fujitsu Ltd, Nippon Electric Co Ltd, Hitachi Ltd, Sharp Corp, Toshiba Corp, Oki Electric Industry Co Ltd, Mitsubishi Electric Corp, and Matsushita Electric Industrial Co Ltd).

2. Research & Development Particulars

The electronic dictionary for natural language processing differs from ordinary machine-readable dictionaries in that it incorporates information needed by a computer to comprehend natural language, hence embracing a wide range of content that allows it to be used by any natural language processing system. This electronic dictionary is made up of a master dictionary, a concept dictionary, and a data management system.

The master dictionary defines concepts represented by language, and expresses both the grammatical characteristics of the words that are the superficial representations thereof, and the Japanese-English correlation.

The purpose of the concept dictionary is to systemize and correlate the concepts defined in the master dictionary.

The purpose of the data management system is to support the drafting, storage, and handling of the other dictionaries, by implementing dictionary control and editing functions.

In addition to implementing the aforesaid master dictionary, concept dictionary, and data management system, the R&D tasks include the creation of a validation and evaluation system for evaluating the effectiveness of the electronic dictionary in systems which employ natural language processing.

The R&D particulars are as follows.

(1) Master Dictionary: Research and develop a Japanese dictionary, English dictionary, Japanese-English conversion dictionary, and English-Japanese conversion dictionary that cover 200,000 commonly used words.

(2) Concept Dictionary: Classify the concepts defined in the master dictionary according to superordinate and subordinate relationships, and thereby systematize the concepts. Also write descriptions that define the attributes of the systematized concepts.

(3) Data Management System: Build editing functions and utilities into the system to draft and operate the electronic dictionary.

(4) Verification/Evaluation System: Develop a system for verifying and evaluating the usefulness and completeness of the electronic dictionary in various applications systems in which it is used. Commence this R&D work in fiscal 1987.

This R&D project is to be roughly divided into three stages, each to last for about 3 years.

3. R&D Program

EDR is organized with a head office and eight research laboratories, with the laboratories disbursed among the research facilities of the eight financing corporations.

The head office includes a general affairs department and a research management department, and is located in the Mita International Building in Minato-ku, Tokyo. Each of the research laboratories is located within several tens of kilometers of the head office, but these, together with the publishing company which is drafting the dictionary and the cooperating company which is creating the software for the data management system, are

organically linked by a distributive R&D support network system which utilizes NTT's DDX-P. The terminals are implemented with the latest highly functional workstations, thus providing an integrated R&D environment.

This network is to be extended in the future to other research organizations with which joint research is conducted.

4. R&D Progress

(1) Master Dictionary: Scheduled in 1986 are the selection of 170,000 headwords for the basic dictionary and the drafting of definitions for 22,000 of these entries. Studies are being done in the interest of making the content of the Japanese dictionary and the English dictionary compatible with general natural language processing, including machine translation. This content and the format to be used for writing it have been determined, and writing and input operations are underway. A great number of usages are being collected and analyzed in order to verify the written content.

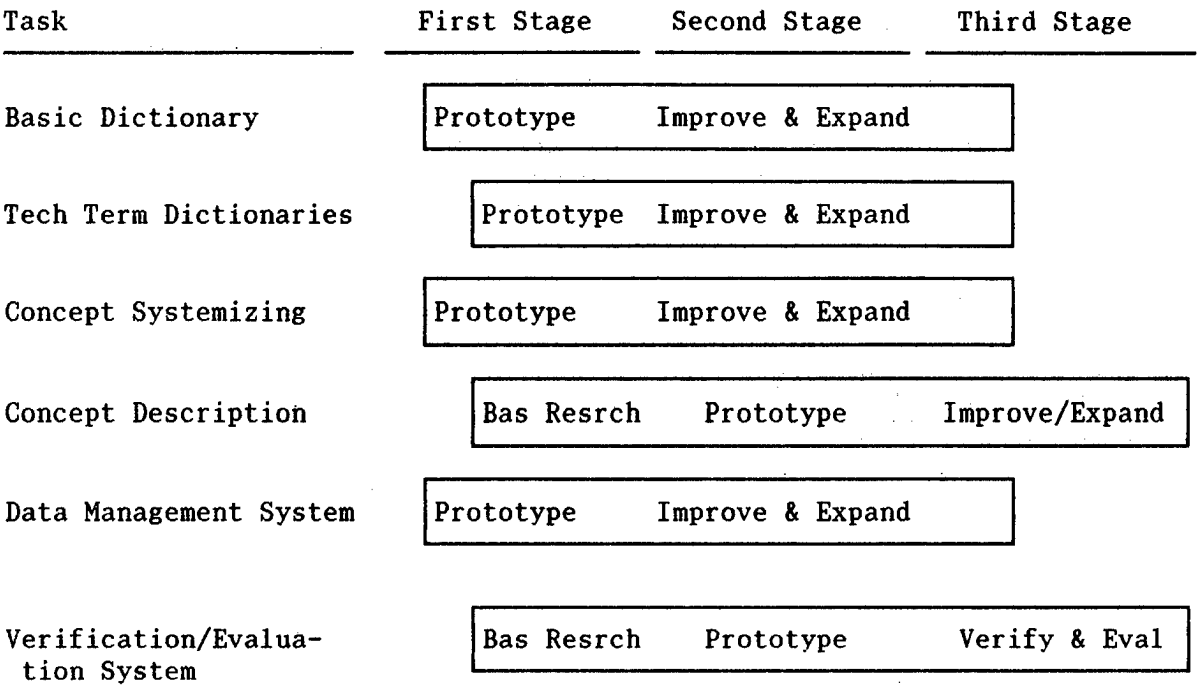
(2) Concept Dictionary: R&D work is being done this year in preparation for the actual concept systematizing which will begin next year. Ways of classifying fundamental concepts are being studied, and trials are being conducted. With respect to concept description, deep-level case surveys already available are being utilized, the inter-concept relationships needed for the concept descriptions are being worked out, and the information (knowledge) necessary from the perspective of textual analysis is being extracted.

(3) Data Management System: In 1986, the dictionary management system for storing each dictionary will be prepared, utilities will be designed to draft the master dictionary from worksheets, a dictionary editor will be designed for correcting the master dictionary, and a windowing system will be designed and tested.

5. Commissioned & Joint Research

The electronic dictionary that results from this R&D project may well become a national and international standard, and will form a foundation for future natural language processing technology. This alone makes it imperative that the best talent available be drawn widely from many quarters. To this end, a close relationship is being maintained with the Institute of New Generation Computer Technology (ICOT), which involves joint research. In addition, joint research is being done with the Electrotechnical Laboratory of the Agency of Industrial Science & Technology, while basic research is also being promoted separately with eight universities. The decision has been made to study the exchange of research findings with the International Informationalization Cooperation Center, with other neutral groups which promote technology, and with related private research facilities. International research exchange and cooperation is also to be promoted as early as possible.

Figure 1 R&D Schedule



12332
CSO: 4306/5027

ICOT/JIPDEC AI CENTER DISCUSSED

Tokyo KOGYO GIJUTSU in Japanese Feb 87 pp 12-14

[Article by Takashi Ichikawa]

[Text] Introduction

The interest in artificial intelligence (AI) technology has been intensifying in recent years. It is believed that industrial demand for AI has grown faster than expected with respect to the development of computer technology that is pivotal for the knowledge and information systems of the 1990's that are being aimed at in the Fifth Generation Computer Project now being carried on as one of Japan's national projects.

This heightened interest involves both the potential of AI business for new industrial opportunities, and the promise of AI technology in terms of industrial and societal infrastructure. Just as microelectronics technology once promoted higher valued-added products in Japanese industry in general, now the trend is to automate the utilization of knowledge through AI technology.

In response to this development, the AI Center was founded in April, 1986, as a joint operation of the the Institute of New Generation Computer Technology (ICOT) and the Japan Information Processing & Development Council (JIPDEC), for the purpose of promoting greater awareness of AI technology in the interest of the public good and of the healthy development of AI technology in industry and society. We now give an overview of the Center and discuss its recent activities.

Purpose, Operating Plans

The interest of the industrial community in AI has been actualized in the commencement of AI tool marketing activities, and also in the commencement, stimulated by the former, of expert-system research-society activities promoted by business groups and corporations in the fields of energy and natural resources, automobiles, electrical machinery, construction, and finance, etc. Adding more fuel to this fire is the publicizing of cases of expert systems using AI products in the United States. The Japanese information industry has also announced AI software tools and is seeking to cope with these developments in the industrial world.

However, great expectations are being entertained for AI technology R&D, and when this develops to the stage of applications technology, it will be necessary to move beyond the perspective of conventional data processing and to take a higher view of the utilization of knowledge information systems. In other words, AI technology, AI products, and AI applications technology will all be at an immature stage of development wating for the introduction of forward-looking knowledge information systems. It is also arguable that much attention needs to be focused on the possibilities for the societal acceptance of AI technology and the problem of industrial and economic developmental overcapacity, as well as on what environmental measures need to be implemented by the government.

Against this background, the AI Center was launched with the objectives of fostering wider awareness and understanding of AI technology, and, in the interest of the public good, carrying on surveys and research in various areas. The implementation of these tasks is to be achieved through the participation of industrial business groups having an interest in AI, regional technology promotion organizations, and private industry.

The Center's operating plans for fiscal 1986 are given in Table 1.

Table 1 Major Operations Planned (Scheduled) by AI Center

1. Promotion of R&D on AI Applications Software
   (1) Sequential-inference machine utilization research
   (2) Making AI research tools available
2. Survey Research on AI Applications
   (1) Surveying AI demand trends
   (2) Surveying AI technology trends
   (3) Surveying AI training trends
3. Promotion of AI Technology Proliferation
   (1) Training of AI technicians
   (2) Accumulation & organization of AI-related information
   (3) Preparation and wide distribution of instructional materials on sequential-inference machines and other computers designed for AI development
   (4) Holding of seminars and orientation meetings
4. Other Operations to Promote Proliferation of AI Technology
   (1) Drafting of registered member lists needed to promote the reciprocal exchange of information among the Center's registered members (associations, companies, etc.)
   (2) Support for and cooperation in operations to achieve AI awareness and proliferation initiated by the Center's registered members
      <1> Convention for reciprocal exchanges between industries inclusive of computer user industries (Disparate Exchange AI Plaza)
      <2> Sponsoring of convention for reciprocal exchanges between regional members (Regional Exchange AI Plaza)
      <3> Other activities sponsored by members to promote awareness and proliferation of AI technology

Table 1 (continued)

(3) Support for and cooperation in various international exchange operations promoted by the Center's registered members

<1> Missions to the United States and other foreign countries sponsored by the Center's registered members

<2> Welcoming fact-finding groups from overseas and introducing registered Center members to them

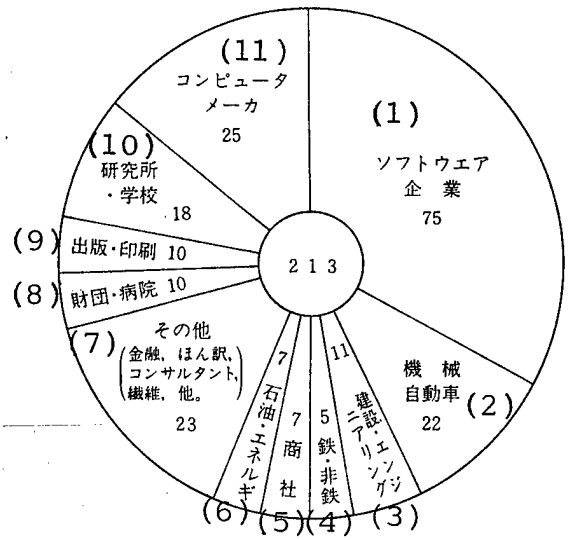
<3> Drafting and overseas distribution of printed materials on AI technology

213 Members Currently Registered

The AI Center began registering members this July. The number of members was 213 as of November 20. A breakdown according to industry type is given in Figure 1. Software companies make up 35 percent of the total with 75 members, followed by computer manufacturers with 25 members (12 percent), the machinery industry (including electrical machinery, precision machinery, general machinery, and automobiles) with 22 members (10 percent), and laboratories and schools with 18 members (8 percent). In some cases the same company has more than one membership, since registration by division or department is permitted.

The registered members participate in Center operations on a volunteer basis (under a free-membership, pay-own-expenses system).

Figure 1 AI Center Members (by industry type, as of 11/20/86)



Key:

1. Software companies 35
2. Machinery, automobiles 22
3. Construction, engineering 11
4. Steel, non-ferrous metals 5
5. Trading companies 7
6. Oil, energy 7

7. Other (finance, translation, consulting, textiles, etc.) 23
8. Foundations, hospitals 10
9. Publishing, printing 10
10. Laboratories, schools 18
11. Computer manufacturers 25

Management Arrangement Between ICOT, JIPDEC

As indicated earlier, the AI Center is currently under the joint management of ICOT (Tadahiro Sekimoto, director) and JIPDEC (Eiji Kageyama, chairman). A joint managerial format involving these two existing organizations is being implemented, for the time being, in view of the potential for broad developments in the field of AI technology as a whole. This is now being implemented by ICOT and JIPDEC undertaking various operations within the framework of their respective organizations and business frameworks. Specifically, ICOT's AI Center office is being administered by the International Survey Department, while JIPDEC's AI Center office is being managed by the Developmental Research Office.

Surveying AI Outlook

It is hoped that AI technology will form a basic technology which will promote high-level informationalization and thereby create new opportunities for growth in Japanese industry. It was decided that the AI Center would work on coming up with an AI outlook as part of its survey operations for 1986. The idea was to evaluate the possibilities of AI based on objective technical and demand data, and make pertinent predictions. To give overall direction to this survey, the "AI Outlook Committee" (chaired by Shigeru Watanabe, president of the Municipal Institute of Science & Technology [Toritsu Kagaku Gijutsu Daigaku]; cf Table 2 for membership) was formed. To do the actual surveys, the Technical Subcommittee (chaired by Hotsumi Tanaka, Tokyo Industrial University [Tokyo Kogyo Daigaku] professor, with six members) and the Demand Subcommittee (chaired by Tadahiko Shimizu, Keio University assistant professor, with 12 members) were formed. To make the scope of the AI surveys more definite, moreover, AI was provisionally defined as "a technology which seeks to analyze knowledge and decision-making abilities used by humans, and subject this information to computer exploitation."

Table 2 AI Outlook Committee Members

Watanabe, Shigeru	President, Tokyo Munic Inst of Science & Tech
Aiiso, Hideo	Professor, Keio Univ, Engineering Dept
Inouchi, Yutaka	Director, Info Systems Research Lab, Sharp Corp
Oshima, Makoto	Director & Mgr, Systems Dept, Kawasaki Steel Corp
Osuka, Setsuo	Prof, Tokyo U, Boundary Domain Research Facility
Oka, Hisao	Sen Manag Dir & Mgr, Development Ctr, Mitsubishi Elec
Ogawa, Yoichi	Sen Manag Dir & Dir, Gen Research Lab, Fuji Xerox
Hinoki, Hiroshi	Mgr, Computer Dept, Electrotechnical Lab, Agency of Industrial Science & Technology
Kawasaki, Jun	Mgr, Systems Development Research Dept, Hitachi Ltd
Kitazawa, Hiroshi	Sen Manag Dir, Mitsubishi General Research Lab

Table 2 (continued)

Kurita, Akihira	Critic
Suzuki, Norihisa	Director, Tokyo Basic Research Lab, Japan IBM
Someda, Tadanori	Dir, Systems Research Lab, Technology Center, Matsushita Electric Industrial Co.
Takahashi, Toshio	Dir & Mgr, Technol Office, Mitsubishi Chemical Indus
Nakagawa, Hiromi	Sen Manag Dir & Mgr, R&D Dept, Kao Soap Co
Nagai, Jun	Sen Manag Dir & Dir, General Res Lab, Toshiba Corp
Nagao, Makoto	Professor, Tokyo Univ, Engineering Dept
Niwa, Kanae	Director, Petroleum Industry Activation Center
Nobuguni, Hiromi	Dir & Deputy Mgr, Data Comm Operations HQ, NTT
Hirayama, Takashi	Director, Tech Research Lab, Tokyo Electric Power Co
Fuchi, Kazuhiro	Sen Manag Dir & Director, Research Lab, ICOT
Marushige, Nagayoshi	Director & Mgr., Central Research Lab, Nissan Motors
Mikami, Tatsuki	Executive Director, Nippon Office Automation Asso
Mizuno, Sachio	Senior Managing Director, Nippon Electric Co
Murata, Minoru	Dir & Mgr, Electronic Office Machine Dept, Canon Inc
Yamamoto, Yoshiko	Senior Managing Director, JIPDEC
Yamamoto, Masatake	Dir & Mgr, Gen Systems Research Lab, Oki Electric Ind
Watanabe, Masanobu	Dir & Mgr, Business HQ, Nippon Digital Equipment
Wada, Hideo	Senior Managing Director, Toyo Information Systems

The following items are scheduled to be included in the AI outlook.

1. Gathering of information beneficial to next 5 years of AI operations development. (Examples: What is AI?, Who will implement AI?, AI business growth potential, AI technology transfer, AI development modes, AI technician training methods, AI implementation and economic benefits, International problems)

2. Relationships with society (Examples: Promoting internationalization, High-level information society and AI, Domestic demand growth and AI, Regional informationalization and AI, Employment problems and AI, Optimizing the AI infrastructure)

3. Objectively writing the history of AI development.

4. Reference materials (Examples: Products, Cases)

Expert System Survey

The JIPDEC AI Center office conducted a survey to find out the current state of expert systems in Japanese industry. This was the first effort made in Japan to discover what the overall trends in expert systems were. In this survey, questionnaires were mailed to 583 computer-using organizations. Responses were received from 203 organizations. The results indicate that 98 of these organizations are engaged in developing expert systems. This represents fully half of the respondents [sic]. Of these 98 organizations, ten already have practical systems. Broken down by industry type, there were 32 in the software or data processing industry, 18 in the

electrical machinery industry, and 7 in the machinery industry. As to system application, 56 percent were diagnostic systems (employed by two out of three companies), followed by design (44 cases or 45 percent), planning (35 cases or 36 percent), and other applications such as forecasting, control, and training.

Publications, Seminars, Etc.

Other planned activities include conducting a survey prior to drafting training guidelines for knowledge engineers (KE's), publishing a bimonthly journal called "AI Center News," holding seminars on tools used in developing AI software, and providing free use of sequential inference machines (PSI) for members.

Concluding Remarks

In the foregoing we have introduced the AI Center. In order to promote the development of AI, it is necessary to seek the solutions to problems through wide participation from industrial and other fields. The AI Center staff will continue actively soliciting registered members and conducting activities to promote a more universal awareness and understanding of AI technology. To do this successfully will require broad support from leaders in many fields.

12332
CSO: 4306/5027A

Σ SYSTEM--OVERVIEW, PROSPECTS

Tokyo DENSHI KOGYO GEPPO in Japanese No 6, 1987, pp 27-36

[Article by Masaki Nakayama]

[Text] 1. Introduction

The Σ System (Σ: SIGMA (Software Industrialized Generator & Maintenance Aids)) is a software production and industrialization system that is the creation of the Σ System Development Center which was inaugurated in October, 1985, within the Information Processing Association (IPA), for the purpose of improving the fundamental environment for software development in Japan.

This joint government-private project, with the cooperation of related companies, has at its disposal a total of 25 billion yen (roughly half of which is from the government's Special Account for Industrial Investment, with the remainder made up from investments by and grants from private industry). The plan is to build a practical system within 5 years, i.e. by 1989, and to begin substantive industrialization in fiscal 1990.

2. Background, Problems

This project was born in the context of the following problems which it is feared will greatly impede future informationalization.

- The expanding gap between software supply and demand as the demand for software grows rapidly
- The increasing proportion of computer systems costs accounted for by software
- The rising demand for higher-quality software as computer systems are used more widely in important fields in society

In order to overcome these problems, the following software development tasks must be accomplished.

- Enhancement of software product quality and productivity
- Promotion of software reutilization
- Improvement of software development facilities, accumulation of know-how, and enhancement of technological capabilities
- Increased efficiency in training software technicians

3. Approach

The following approach will be followed in this project in order to achieve the aforesaid tasks.

(1) Establishment of Standard Software Development Environment Independent of Program Executing Hardware

Fundamentally, this involves the integration of program development hardware facilities, basic hardware (including operating systems), and software utilities (or "tools"), from which an environment is created in which these are all organically connected by a network. The programs developed in this environment can be run on various types of executing hardware.

(2) Establishment of Network System for Retrieving, Transmitting Technical Information on Programs

This is a network system that facilitates the joint use and exchange of technical information among individual software technicians. It is on this network that the Σ System--which will accumulate, distribute, and exchange information that should be jointly used by all the Σ System users--will be implemented.

4. Development-Related Organizations

In order to consolidate the full power of Japan's information processing industry, the development work is being coordinated by the IPA through the following organizations.

(1) Σ System Development Center

As of April, 1987, the Σ System Development Center is made up of some 50 persons, including IPA staff members and technicians sent from 36 companies. These persons are now engaged in basic developmental design, progress monitoring, and overall project coordination.

Planning Office	Planning, coordination, public relations
Management Office	Budget management, accounting, general affairs
Development Planning Office	Development planning management, general testing management, monitor testing management, etc.
Development Lab No 1	Building the Σ System
Development Lab No 2	Developing the Σ operating system and common utilities, general utility coordination, etc.
Development Lab No 3	Development of utilities for business processing field, etc.
Development Lab No 4	Developing utilities for technical fields, etc.

(2) Committee

The Σ System Development Committee (made up of 52 highly qualified and experienced persons and chaired by Yutaka Ohno, Kyoto University professor) has been formed to oversee important matters connected with the creation of the Σ System.

Attached to the Development Committee are the Technical Committee (chaired by Yutaka Ohno) to review specifically technical matters, and the Management Committee (chaired by Tatsuo Watanabe, executive director of the foundation Database Promotion Center) to review specifically managerial matters. These two committees meet bimonthly.

The Technical Committee advises on important technical issues that cover a wide spectrum, while the Management Committee concerns itself with problems relating to software rights, monitor system, fee structures, and other managerial matters.

5. Basic Plan

A fully operational Σ System will not be quickly and comprehensively developed. In the first stage a Σ prototype system will be developed which will implement experimental services (monitor). Then in the second stage the system will be enhanced and developed fully, based on various industrial trends and on how well the monitor system performs.

(1) First Stage

- Version 1 of Σ operating system which will form the basis of the standard development environment
- Utility groups necessary for developing the Σ System itself, and content utility groups which can verify the effectiveness of productivity enhancements on the monitor
- Σ Center which can operate and control the entire Σ System
- Σ database which can access data experimentally
- Management system needed for basic information exchange and for building the Σ System
- Management system needed for such Σ System developmental tasks as collecting factual data

(2) Second Stage

- Enhancement & expansion of Σ operating system functions
- Enhancement of utility group functions and expansion of scope of applicability
- Enhancement of Σ Center and Σ Network, giving priority to improved security

6. System Configuration

The Σ System is made up of Σ user sites where individual software developers develop software, the Σ Center where information is accumulated and made available to users, the Σ Network which provides linkage internally at the Σ user sites and externally between multiple Σ user sites, and the Σ utilities that are employed at Σ work stations in developing software.

(1) Σ User Sites

A Σ user site is a decentralized development environment in which multiple Σ work stations are integrated via LAN's or dedicated lines. The development work is done using the various development support utilities (or "tools") which are necessary for software development and implemented in the Σ work stations.

The Σ Center database is provided with utility groups so that needed utilities can be utilized through the Σ Network.

(i) Σ Work Stations

The objective here is to achieve a cost/performance ratio that will allow each software technician to have his or her own station. The following specific conditions have been set down.

- Each Σ user can wield enormous computer power by himself.
- Powerful network functions facilitate organic linkage with the Σ Center.
- Superior user interfaces make it possible to conduct both Japanese text processing and graphics processing such as flowcharting in an interactive mode.
- Interfaces with LAN's are provided which enable LAN-resident resources (files, peripherals, etc.) to be jointly accessed and permit function sharing.
- The Σ operating system is run, permitting the utilization of software development tools provided by the Σ Center.

The features for the prototype Σ work-station hardware noted in the table have been established as necessary in interfacing with the work-station software used in the monitoring system. The prototype Σ work stations, which run the Σ operating system, satisfy these requirements. They are being developed by the individual companies participating in the Σ Project.

Nine companies had begun delivery of these work stations by the end of 1986, and a number of other companies are engaged in development.

(ii) Σ Operating System

One necessary external component for the Σ operating system is an integrated function interface with which the various functions necessary for software development can be achieved so that they will be standardized and highly interchangeable. The Σ operating system development conditions are as follows.

- The UNIX functions are to be based on the AT&T version of UNIX but also incorporate the useful functions of the Berkeley version, while the software development tools are to be operable in the Σ operating system without the need for elaborate transplant operations.

- Japanese text processing, graphics, multiwindowing, and communications functions are also to be added.

- Upward compatibility will be maintained to the fullest extent possible.

- The design should give due consideration to compatibility with international UNIX versions and to software circulation within the UNIX community.

Based on such conditions as these, a function specification manual was compiled for the Σ operating system (initial version), and the external requirements for the Σ operating system were completed.

With these Σ operating system external requirements, system calls and commands were added specifically for software development and communications, taken from the 4.2 BSD based on System V Release 2.1. Textualizing support tools and other Σ tools have already been developed, and these have been used in verification tests and in integration tests in linking between the Σ work stations of different manufacturers with the Σ Network.

An improved version of the Σ operating system is under development which will feature multimedia windows and a DBMS. This version may be ready as early as the second half of fiscal 1987. Then, building on the System-V Release 13 survey results, the specifications for the full-blown version of the Σ operating system are to be completed.

(2) Σ Network

The Σ work stations are mutually networked with LAN's or dedicated lines, forming the matrices of an integrated decentralized development environment. These are the Σ Network user sites. The environment inside each user site can be constructed and managed individually. With the Σ Network, moreover, it is possible to mutually connect multiple

user sites with a DDX network and provide the same services between sites that are available within a site. Thus the Σ Network is built up into a composite of multiple independent networks, i.e. an internetwork.

The lower level of this network is implemented with the TCP and UDP protocols, which are applied to DDX-P and serial lines as well as to LAN's.

In order to implement this and to bridge the physical network and the virtual network, there is a Σ name server which manages names, and three types of resource--namely "services," "users," and "files"--exist inside virtual computers which correspond to each organization (i.e. domain) inside each user site. The following services will be provided initially on the Σ Network.

- Network Applications
  Functions to aid information transfer between users
  - Electronic mail
  - Electronic bulletin board
  - Electronic conversation
  - File transfer
  - Virtual terminals
- Network Environment Querying Services
  Queries concerning either Σ Network configuration or operating status, or personal information
- Network Environment Building Services
  Various functional services for use by managers at user sites in creating and managing networks inside their sites

The individual tests have now been completed and tests are being done in integrating with the Σ operating system. System tests in LAN environments inside user sites are now being carried on, to be followed by DDX connection tests between user sites.

(3) Σ Utilities

The Σ utilities are software tools which provide means for carrying on software development operations on Σ work stations. These utilities are not dependent on the Σ work-station model. Σ utilities will be provided which are interchangeable and expandable, making it possible to define and publicize data architectures to interface between the various utilities, to develop new utilities in accord with these specifications, and to incorporate improved versions of existing utilities of proven effectiveness. Σ users will work no longer in a conventional centralized development environment in which terminals are connected to a mainframe, but each will be provided with the necessary software tools at his or her own Σ work station, so that he or she can make full use of the functions of the Σ work station and Σ utilities in a decentralized software development environment.

The Σ utilities are made up of a common utility group used irrespective of the application field, and field-specific utility groups used in certain fields.

(i) Common Utility Group

Not only are the common utilities necessary for each and every Σ user, but by using the same utility, greater efficiency is promoted in the areas of common effort which arise in connection with developing software. Thus these utilities are designed to provide a common environmental base for software development.

The basic elements of the textualizing support utilities and library management utilities are now being produced and tested, while design work is going ahead concurrently on Version 1 which features expanded functions.

In the man-machine interface (MMI) area, a library and desktop are now being designed and are scheduled to be completed in the second half of 1987.

Work is being done on all the utilities so that they can be implemented in the various work stations in the second half of 1987, while the functions are being successively expanded so that they can be provided for the monitor.

a. Textualizing Support Utilities

These utilities are designed to promote efficiency in preparing the various kinds of text which must be drafted during the course of software development on a Σ work station. They will provide functions which will facilitate the drafting of Japanese text and graphics.

The external views of hardware needed for product planning in the upstream phases of software development, for example, or charts for the detailed design work in the downstream phases, can be easily prepared and edited. The following functions will be provided.

- Multiwindowing
- Reciprocal exchange of text with remote sites
- Text information interface with other utilities

The standard text format presupposes the adoption of ODA (office document architecture) in standardizing the OSI, and an access library will be prepared to permit partial text access.

Also being studied is the future addition of image processing functions.

b. Project Management Utilities

The following function will be provided to support performance monitoring and progress management from the drafting of the software development process plans.

- Process management functions
- Cost management functions
- Estimating functions
- Quality control functions
- Report support functions

Adequate customizing functions will be provided to cope with different management approaches among users. Various kinds of graphs will be visually displayed so that a manger can surmise the situation at a glance.

c. Library Management Utilities

These utilities enable the user to centrally manage the various intermediate and final products such as programs, specifications, and test data which are produced in the course of software development. Each function is being developed by adding visual man-machine interfaces to original standard UNIX functions, with due consideration given to the linkage between these functions and the existing utilities provided with UNIX and the mainframe computer.

d. Man-Machine Interface Support Library

This is a library of functions designed to implement a man-machine interface featuring multiwindowing with which a number of jobs can be performed concurrently on one Σ work station. Standard non-hardware-dependent interfaces are here established at the library level for the Σ utilities and the application software.

(ii) Field-Specific Utility Groups

These utilities are designed to support software development in specific fields. The objective here is to create a total development environment that will provide comprehensive support throughout the entire software development life-cycle with due consideration given to linkage with the target machine in a development-dedicated environment on the Σ work station.

These groups are implemented by combining the utilities that can employ the necessary functions individually. Many utilities are included which have proven their effectiveness. A data architecture is defined to interface between the utilities so as to promote the extension and development of each utility and to permit data interchangeability between utilities as well as the most effective combinations thereof.

a. Business Processing Field Utilities

These utilities are designed to support software development in which the COBOL language is employed.

Emphasis is given here to network-oriented utilities for the virtual environment on the Σ Network to better facilitate joint development work involving many programmers, and the utilities are being designed for broad compatibility with the development techniques implemented on mainframe computers.

Connections will be made to a target system built around a mainframe, using RJE, file transfers, virtual terminals, and other connecting functions. As a general rule, functions that are not dependent on specific target systems will be implemented on the Σ work stations, while utilities will be provided for such target-dependent functions as DB/DC and Japanese text handling so that the resources of the target system itself can be utilized.

A utility manager, moreover, will make it possible to define combinations of utilities necessary for the development operation and to automatically invoke a battery of utilities.

The development work is being pursued in the follow three phases, oriented toward integrated software production support.

- Phase 1

Utility group to support both downstream design processes focused on data design and program design, and program synthesis through component utilization

- Phase 2

Utility group to provide support for tests done on the target system and the Σ work stations, to provide utility management functions for utility coordination, and to otherwise facilitate target connection

- Phase 3

Utility group to support both the upstream design processes involving demand definition and maintenance support utilizing software DB

The function designing of Phase 1 has now been completed, and production will be implemented stepwise beginning in fiscal 1987.

Product plans are now being drafted for Phase 2, focusing on test process support, while planning for Phase 3 is scheduled to begin in the second half of 1987.

b. Utilities for Scientific-Technological Computation, Process Control Field

These utilities are designed to support scientific and technological computation and process control. They provide support for all the work down beginning with the upstream processes, and include debugging and testing functions which do not use the target system. In terms of process control, support is given to system performance and reliability evaluations that are based on prolonged runs of the total system. Effective system diagnostic and maintenance functions are also provided for the target system via the Σ Network.

c. Microprocessor Field Utilities

These utilities provide assistance for all work done beginning from the upstream processes, and powerfully support all software development operations, from assembly language work to high-level language work. These support tools are designed for general-purpose use with various microprocessors (MPU's). They will enhance utility investment effectiveness and facilitate prompt support for new chips. Debugging and testing functions will be provided for the C language source level, target connection, and targetless systems.

By the first half of 1987, development work will be completed on the basic utilities for programming processes and debugging/testing, for the fields of both scientific-technological computing and process control. Then, in the second half of 1987, support will be broadened to the required specification definition process and design process, and real-time operating-system supports will also be extended.

With respect to the ΣICE, which emulates MPU functions, the ΣICE-ID was publicized in April, 1987. This defines the ΣICE function specifications, command specifications, and Σ work-station transmission specifications.

(4) Σ Center

The Σ Center provides lateral support for the creation of environments in which users conduct software development, and for the software development which employs this environment. It is a management headquarters structure for administering the entire Σ System, and is made up of five subsystems that provide various types of database information.

Each subsystem is built on a computer running a UNIX-type operating system, and these are all connected via Ethernet.

(i) Database Subsystem (DBSS)

In order to prevent duplicate development of the same products by employing the latest technological and industrial information, this subsystem facili-

tates the management of various kinds of information on the database and provides suitable utilities and packages to the users.

The subsystem accumulates and, on demand, retrieves program information for software reutilization as well as case information in the interest of the joint use of developmental know-how.

Information demand is now being widely surveyed and preparations are being made for a database for the next field.

- Software Information:
  Catalog information on utilities, application packages, DBMS, system software, and other software products

- Service/Company Information:
  Introductory information on DB services and software development companies, etc.; information on training and events

- Σ Information:
  Information on Σ System bugs; other information for people who utilize the Σ System

- Hardware Information:
  Catalog information on computers and peripherals

- Reference Information:
  Technical articles appearing in newspapers and magazines

- Case Information:
  Information on environment building cases, software and system development cases, and factual data relevant to cost estimates, etc.

The main focus here is on supplying data from outside information-providing companies. Consideration is being given to network connections with external databases and providing product downloading services for software in addition to reference information.

(ii) Network Subsystem

The network subsystem manages network information for each site and supports intersite connections, while also providing services and file transfers that can be used at the site level, as well as electronic mail and electronic bulletin board services, etc.

(iii) Demonstration Subsystem (DEMOSS)

This subsystem creates a simulated user-site environment to further Σ user understanding and promote system comprehension and proliferation. Various Σ work stations and Σ utilities will be provided in a demonstration area set up in the Σ Development Center located at

Akihabara, where Σ services are to be demonstrated. Consideration is also being given to services which can be tried out from the Σ user sites via the Σ Network.

(iv) EDP Subsystem (EDPSS)

This subsystem will perform the business, clerical, and statistical processing that will become necessary when the Σ System is operated as a business, and will aid in the development of the software necessary for such processing.

(v) Development Environment Subsystem (KKSS)

This subsystem monitors and manages the various subsystems of the Σ Center, collects other information, and otherwise supports the developmental work and verification operations for the entire Σ System.

The hardware has now been installed in the Σ Center and application software integration tests are underway.

Integration and systems testing are also moving ahead so that the superminicomputers and terminals already installed in the Σ System Development Center can be connected to the equipment mentioned above and operated integrally with the Σ Center.

7. Concluding Remarks

The Σ System Construction Project is achieving most of its objectives. Prototype Σ work stations are now operational, and work is going ahead on the Σ Network, Σ utilities, and Σ Center according to the development schedule set forth in the basic plans. Studies are also being made on the implementation specifics, operating guidelines, implementation plan, scheduling, and other factors involved in implementing the monitor tests scheduled for the second half of this fiscal year. Manufacturers of Σ work stations have begun to move into the product creation stage, and are poised to take the first step toward concrete system embodiment.

A publication called "Σ News" is now being issued four times a year to raise the level of Σ System consciousness, and the "Σ Symposium" is being held twice a year as a forum for progress reports and the exchange of relevant opinion.

As progress is made in building this system, more problems are arising and the workload is increasing, but everything possible is being done to overcome these problems, and broad support for the project is expected to continue.

Figure 1 Σ System Schedule

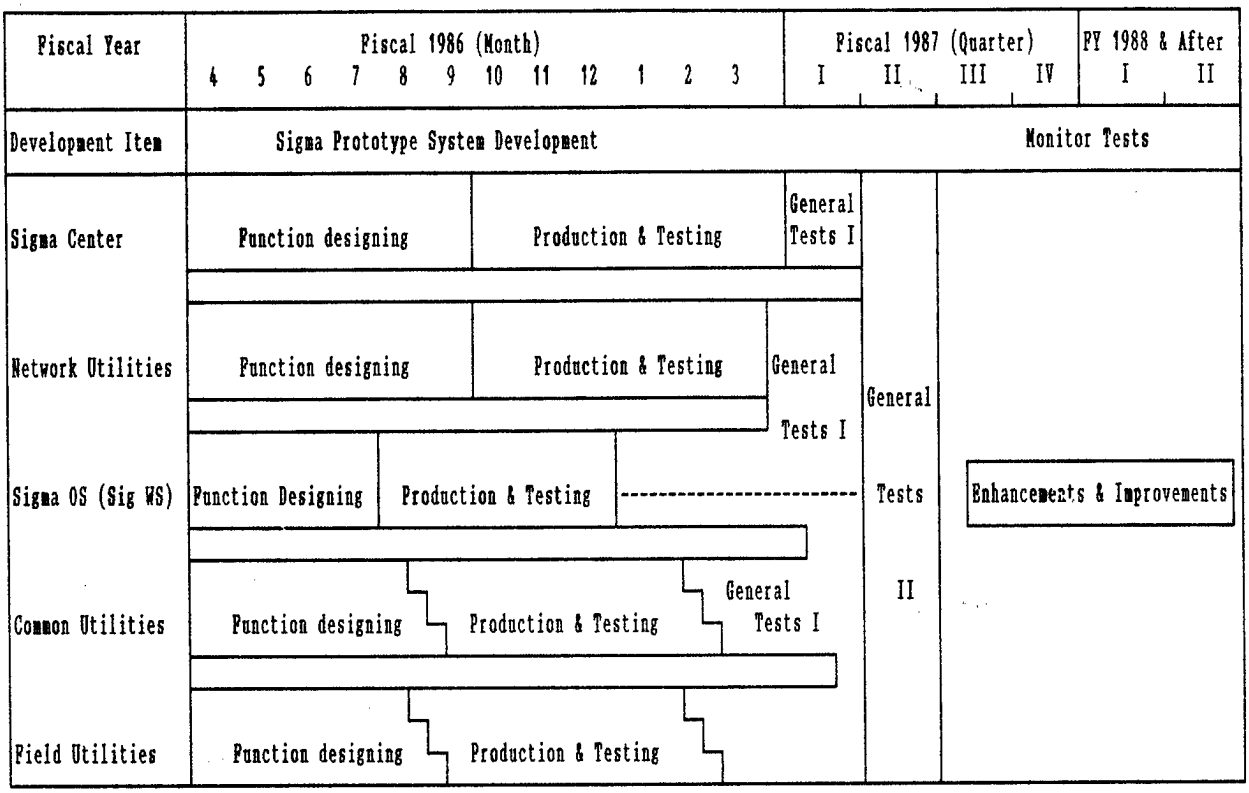
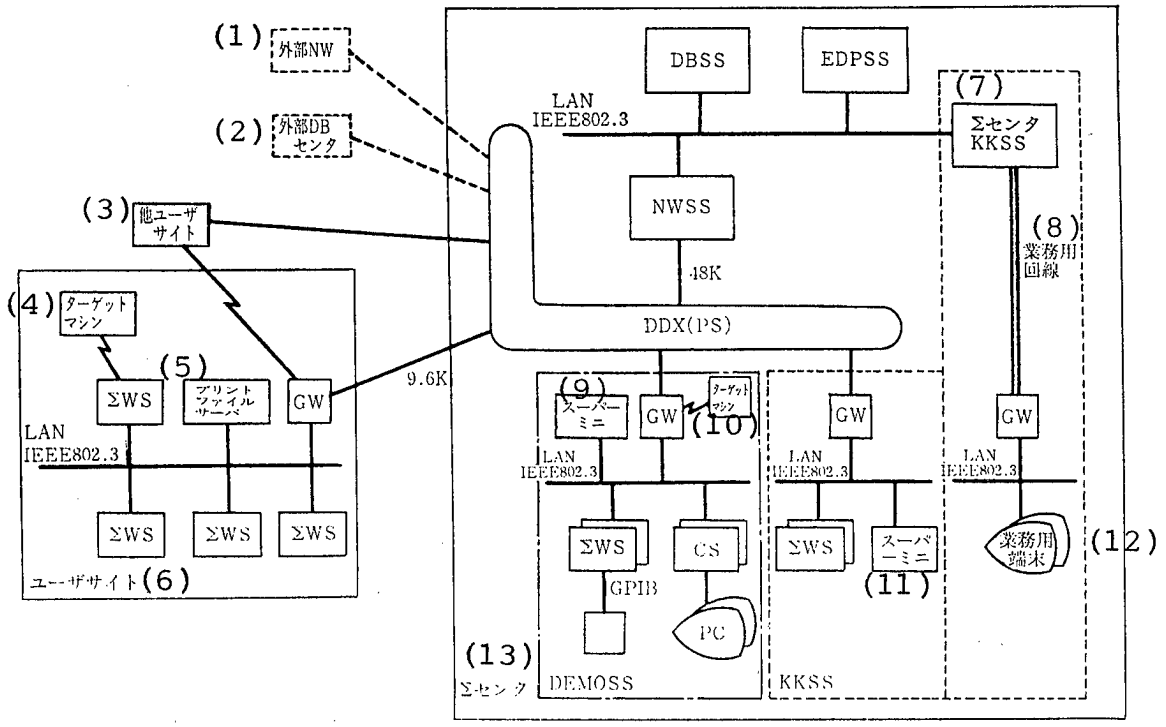


Figure 4 Σ Center Layout



Key to Figure 4:
1. External network
2. External database center
3. Other user site
4. Target machine
5. Print file server
6. User site
7. Σ Center KKSS
8. Line for operational use
9. Superminicomputer
10. Target machine
11. Superminicomputer
12. Terminals for operational use
13. Σ Center

Table 1 Hardware Requirements (Excerpts) for Prototype Σ Work Station

Item		Hardware Requirements for Implementing Σ OS-V0
Control Mechanisms	CPU	Internal registers 32 bit
	Floating Points	Floating point operating mechanisms required, internal expressions in IEEE format
	Main Memory Capacity	4 megabytes or more
	Logical Space	8 megabytes or more
File Mechanisms	Hard Disk	Capacity available to user must be 20 megabytes or more
	Floppy Disks	2 5" HD or 2 8" D for use in exchanging data
	Back-Up	The system should have back-up functions
Display Mechanisms	CRT Resolution	Graphics: 1024 x 768 dots or more Text display (Kanji: 24 x 24 dots): 40 characters x 24 lines
	Keyboard	Key layout must satisfy JIS; 10 or more function keys
	Mouse	2 buttons or more
	Printer	Not specified for Σ OS-V0
External Interface	Serial Interface	2 or more RS232C (V.24) jacks
	Parallel Interface	Centronics interface (optional)
	LAN Interface	IEEE 802.3 compatible
	DDX-P Interface	V.28 (X.21bis) or V.11 (X.21)
	GPIB Interface	For use with ΣICE interface (optional)
Software Protection Mechanism		Studying protection mechanisms implemented in hardware

12332
CSO: 4306/5076

JAPAN, U.S. TO BOIL DOWN JOINT ANTISUB BID

OW160803 Tokyo KYODO in English 0543 GMT 16 Aug 87

[Text] Tokyo, 16 Aug (KYODO)--Japan and the United States will finalize the framework for joint research on ways to combat improved Soviet submarine-detecting capability at defense minister-level talks next month, Defense Agency sources said Sunday.

The two countries are also expected to settle the controversial issue of selecting the next-generation support fighter model (FSX) for Japan's self-defense forces (SDF), the sources said.

Defense Agency Chief Yuko Kurihara will visit the U.S. in late September for the talks with Secretary of Defense Caspar Weinberger, the sources said. Kurihara will visit the U.S. at the invitation of Weinberger who came to Japan last June.

SDF officials and the U.S. Department of the Navy agreed in recent working-level negotiations held in Hawaii to improve submarine-monitoring and detection capability, stepped-up joint antisubmarine drills and continued ocean observation.

In the forthcoming talks with Weinberger, Kurihara will make concrete proposals on the antisubmarine issue, which surfaced after illegal sales by Toshiba Machine Co. of sophisticated milling-machine technology which allowed the Soviets to make quieter submarine propellors.

/9738
CSO: 4307/036

JAPAN'S AEGIS SHIP ESTIMATED AT ¥140 BIL.

Tokyo AEROSPACE JAPAN-WEEKLY in English 10 Aug 87 p 3

[Text]

The Defense Agency (JDA) has worked out an outline of the AEGIS ship to be deployed by the Maritime Self-Defense Force (MSDF) for ocean air defense with a view to requesting funds for the first ship under the FY 1988 budget.

Japan's AEGIS ship is estimated to cost about ¥140 billion in consideration of recent strong yen. Its tonnage will be 6,500-7,000 tons. It will exceed the present DDG missile-armed destroyers of MSDF in all aspects, including the cost, performance and size.

Under the current FY 1986-90 Medium-Term Defense Buildup Program (MDBP), JDA plans to purchase two AEGIS ships (one in FY 1988 and the other in FY 1990). In the future, it plans to deploy a total of eight AEGIS ships or two ships with each of the four Escort Flotillas.

/13046
CSO: 4307/038

MELCO, MHI COMPETING FOR AEGIS SYSTEM

Tokyo AEROSPACE JAPAN-WEEKLY in English 10 Aug 87 p 5

[Text]

As the Defense Agency (JDA) plans to fund the first AEGIS ship under the FY 1988 defense budget, Mitsubishi Electric Corp. (MELCO) expects to win an integration contract for the AEGIS shipborne air defense system.

Mitsubishi Heavy Industries, Ltd. (MHI) and Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) have already been competing with each other for shipbuilding and powerplant contracts of the AEGIS ship. MHI, in particular, aims at undertaking overall integration of the ship, including the AEGIS system.

Major parts of the AEGIS system are likely to be introduced on the basis of FMS (foreign military sales), according to JDA sources. But even in this case, there has to be a prime contractor who builds up systems, including connection of the AEGIS system with domestic electronics and weapons, and modifications for use by the Maritime Self-Defense Force (MSDF).

MHI wants to undertake the system rigging as well as the shipbuilding as an overall integrator. But MELCO believes that it deserves giving the system prime contract because of its wide experience in missiles and weapon control systems.

MELCO is now studying the upper structure of the ship where the AEGIS system is to be installed. It will also study feasibility of domestically-built phased-array antenna which will be installed on the bridge.

In the U.S., RCA Corp. and the Navy took the initiative of the AEGIS development program. When the system is introduced to Japan, however, it will not be necessary to tie up with RCA.

As a result of MELCO's entry, there expected to be some changes in the AEGIS ship competition. MHI wants to monopolize the AEGIS ship contracts, including both the shipbuilding and system integration contracts, for not only the first ship but also the follow-on ships.

If the contracts for shipbuilding and system integration should be awarded separately, IHI may try its best to win the shipbuilding contract since its air defense system development is behind the competitors.

/13046
CSO: 4307/038

MSDF TO STUDY IMPROVED ACTIVE SONAR

Tokyo AEROSPACE JAPAN-WEEKLY in English 27 Jul 87 pp 3

[Text]

The Maritime Self-Defense Force (MSDF) will study an improved active sonar to be installed aboard a helicopter. Many sonars now in use are passive types which detects sounds of submarines. But such passive sonars would be useless against sound-proof submarines with quieter engines.

To cope with such quiet submarines, MSDF plans to improve conventional active sonars. It will start in-house studies in FY 1987. If and when the planned active sonar improvement becomes feasible, MSDF plans to move to full-scale research and prototype fabrication.

If and when the improved sonar is completed, it will be installed on the SH-60J new ASW helicopter which is now under development. MSDF also plans to equip the P-3C ASW aircraft with the planned improved sonar with some modification added.

/13046
CSO: 4307/038

DEFENSIVE SYSTEMS FOR P-3C

Tokyo AEROSPACE JAPAN-WEEKLY in English 27 Jul 87 pp 3-4

[Text]

The Technical R&D Institute (TRDI) will shortly start research on defensive system for the P-3C ASW aircraft of the Maritime Self-Defense Force (MSDF). Though the P-3C is equipped with detection and offensive systems against submarines, it is practically not armed against attacks in the air.

MSDF does not necessarily want to arm the P-3C like an attack fighter but it wants to make the aircraft defensive to some extend. For this purpose, TRDI will study the following two defensive systems for the P-3C.

Infrared Jammer for Large Aircraft. In an electronic warfare environment, the infrared jammer is aimed at jamming radar signals before the enemy detects the aircraft position for attack. First of all, TRDI will study the so-called IR jammer which disturbs IR homing radars.

Airborne Fleet Air Defense System. This is aimed at modifying the conventional fleet air defense weapons for installation on aircraft. Specifically, rockets will be mounted in pylons of the P-3C to attack enemies.

/13046
CSO: 4307/038

ASDF SELECTS HH-60J FOR NEW SAR HELICOPTER

Tokyo AEROSPACE JAPAN-WEEKLY in English 10 Aug 87 p 1

[Text] The Air Self-Defense Force (ASDF) has selected the Sikorsky HH-60J for its new search and rescue (SAR) helicopter to replace the currently operational Kawasaki/Vertol KV-107A. ASDF plans to request funds for about three helicopter under the FY 1988 budget.

ASDF's requirements for a new SAR helicopter included a higher speed and a longer range than the KV-107A. According to these requirements, candidates were narrowed down to four helicopters, including the Sikorsky HH-60J, the Bell 214ST, the Aerospatiale AS332M and the Kawasaki V-107 Kai (modified).

The helicopter selection was to be made last year. But ASDF postponed its decision a year because of some uncertain factors such as prices and production systems of the proposed helicopters. So, it purchased four KV-107As instead of introducing new helicopters under the current FY 1987 budget.

The HH-60J, of course, meets ASDF's requirements. But a major reason for ASDF's selection of the HH-60J is that the Maritime Self-Defense Force (MSDF) will also operate the Sikorsky SH-60J ASW helicopter.

The SH-60J program will shortly enter a full-scale production stage. MSDF will also request funds to purchase the new ASW helicopters under the FY 1988 budget. The SH-60J will be manufactured domestically by Mitsubishi Heavy Industries, Ltd. (MHI) under license.

Since the HH-60J uses the same airframe and engine as the SH-60J, the new SAR helicopter can be built by MHI too with some modification of the airframe and on-board equipment of the SH-60J.

Now the Sikorsky H-60J will be operated by both MSDF and ASDF. This may influence the future helicopter selection by the Ground Self-Defense Force (GSDF) too which operates helicopters in a similar class.

GSDF will shortly start selection of a new helicopter to replace the HU-1 with a view to beginning the purchase in FY 1990. As the prospects now stand, GSDF will likely choose the UH-60J too since both MSDF and ASDF will use the H-60J series.

/13046
CSO: 4307/038

ASDF BRIEFED ON BAe 125-800 FLIGHT CHECKER

Tokyo AEROSPACE JAPAN-WEEKLY in English 10 Aug 87 p 2

[Text] The Air Self-Defense Force (ASDF) was briefed July 22 on the BAe 125-800 flight checker by a British Aerospace sales team headed by Rex Griffiths, Project Manager - BAe 125 of the Civil Aircraft Division.

ASDF plans to introduce new flight checkers or the so-called FC-X next year. It was the first official sales team sent by the British aircraft manufacturer in view of Japan's FC-X program. The team left Japan on July 29.

The BAe 125-800 is counted as one of the final candidates for the Communications-Flight Inspection Aircraft (C-FIN) program of the U.S. Air Force along with the Canadair CL601 Challenger and the IAI Astra. The U.S. Air Force is expected to choose one from the three candidates in September this year.

The BAe 125-800 perfectly satisfies the U.S. Air Force's requirements and its cost-performance efficiency is excellent too. It is also the best aircraft for ASDF's FC-X program, according to British Aerospace.

For the U.S. Air Force's C-FIN program, the BAe 125-800 is equipped with an automatic flight inspection system supplied by LTV - Sierra Research Division. The aircraft can be equipped with similar system of other manufacturers too.

More than 670 BAe 125 series aircraft have been sold in the world and nine aircraft are operated as flight checkers in seven countries. Cornes & Co., Ltd. and Kanematsu-Gosho Ltd. are assisting British Aerospace in the aircraft sales in Japan.

/13046
CSO: 4307/038

JAPAN MAY HAVE TO DEPLOY MORE P-3C'S

Tokyo AEROSPACE JAPAN-WEEKLY in English 10 Aug 87 pp 2-3

[Text]

In the wake of the Toshiba case, the U.S. is likely to ask Japan to enhance its anti-submarine warfare capabilities with deployment of more P-3C ASW aircraft and surface ships equipped with improved sensors and torpedoes.

The U.S. believes that illegal exports of sophisticated milling machines to the Soviet Union by Toshiba Machine Co. allowed the Soviets to make their submarines quieter and more difficult to detect.

Defense Agency Director General Yuko Kurihara and U.S. Secretary of Defense Caspar Weinberger earlier agreed that the two countries will cooperate with each other in countering such quieter Soviet submarines. As part of such efforts, Japan may be asked to deploy more P-3C ASW aircraft.

The Maritime Self-Defense Force (MSDF) now plans to deploy a total of 100 P-3Cs and 69 of them have already been deployed. The P-3C has been manufactured by Kawasaki Heavy Industries, Ltd. (KHI) under license from Lockheed.

/13046
CSO: 4307/038

U.S. ASKS JAPAN TO BUY MK48 TORPEDOES

Tokyo AEROSPACE JAPAN-WEEKLY in English 10 Aug 87 pp 3-4

[Text] Amid growing pressure for Japan's purchase of American weapons like the FS-X next support fighter, Japan has been asked to purchase torpedoes from the U.S. too for installation on submarines of the Maritime Self-Defense Force (MSDF).

The U.S. has asked Japan to purchase the Mk48, the latest torpedo now used in the U.S. Navy's submarines. To cope with high-speed Soviet nuclear-powered submarines, the Mk48 is said to be made faster and stronger to travel deeper in the water. It is said to be equipped with a computer-aided targeting system.

The U.S. has classified this torpedo technology and rejected to provide it to Japan for security reasons. So, Japan decided to develop its own torpedo called GRX-2 to replace the currently used Model 80 torpedo. As the GRX-2 development was completed last year, the Defense Agency (JDA) was to request funds for the new domestic torpedo under the FY 1988 budget.

The U.S., however, has changed its policy and asked Japan to buy the American torpedo for the following reasons:

- The Mk48 is much superior to Japan's GRX-2.
- It is desirable for Japan and the U.S. to use the same torpedo in terms of maintaining interoperability of the two countries.
- The Mk48 is less expensive and more efficient than the GRX-2.
- Purchasing a large amount of American weapons gives favorable political impact to the U.S. Congress.

JDA, however, believes that the Japanese torpedo is not inferior to the Mk48 as the U.S. claims. And now it is too difficult to give up the GRX-2 program since Japan has already spent a large amount of money to develop it.

/13046
CSO: 4307/038

TRDI TO BEGIN RPV RESEARCH PROGRAM

Tokyo AEROSPACE JAPAN-WEEKLY in English 10 Aug 87 p 4

[Text] As the XJ/AQM-1 unmanned target drone successfully completed technical and operational tests last year, the Technical R&D Institute (TRDI) will start a full-scale research on an unmanned RPV (remotely piloted vehicle) this year.

Basic research on RPV has already been underway within TRDI. To inaugurate full-scale research on RPV, TRDI will request funds under the FY 1988 budget.

TRDI's planned RPV is aimed at supplementing reconnaissance missions which are currently performed by manned fixed-wing and rotary-wing aircraft. It will also study technology required for a medium-size, high-speed RPV which is capable of performing various other missions.

/13046
CSO: 4307/038

ENERGY INDUSTRIES OF ASIA, OCEANIA: CURRENT STATE, OUTLOOK

Tokyo MARUBENI PETROLEUM REPORT in English 16 Aug 87 pp 5-6

[Text] --A report published by the study mission of MITI's Agency of Natural Resources and Energy.

The Pacific energy cooperation study mission dispatched this spring by the Agency of Natural Resources and Energy published a report titled "Energy Industries of Asia and Oceania: the Current State and Future Prospects."

According to the report, Asia and Oceania account for 17% of world primary energy consumption, with China and Japan representing 50% and 30%, respectively, of this region's total consumption. As for oil, this region's consumption as a percentage of world consumption is high for its share of world oil reserves and production. Thus, Asia and Oceania depend highly on other regions such as the Middle East. But except for Japan, which consumes half of the oil used in Asia and Oceania, countries in this region keep their supply and demand situations well balanced.

Among these nations, production and consumption of coal are also well balanced, and there are large untapped deposits of low-grade coal in such countries as Thailand and Indonesia. China has large shares of both the production and consumption of coal in this region.

Among other energy sources, natural gas is still in the initial stages of development and utilization, and hydropower resources offer great potential for development.

The report also states that despite the second oil crisis of 1979, overall energy demand in Asia and Oceania increased at a high average annual rate of 3.6% from 1975 to 1984. In Japan, however, energy demand during the same period grew by a low 1.4% annually. Similarly, overall energy demand growth in this region is projected to post an annual average of 3.9% in 1984-2000, as compared with the 1.5% projected for Japan and the approximate 2% forecast for the world as a whole.

/13046
CSO: 4307/037

PROJECTIONS FOR ENERGY, OIL NEEDS THROUGH 2000

Tokyo MARUBENI PETROLEUM REPORT in English 16 Aug 87 pp 1-3

[Text] The Petroleum Association of Japan recently published a report titled "Long-Term Energy Supply/Demand and Oil Supply/Demand Projections -- the Outlook for Japan in the Year 2000." According to this report, Japanese primary energy supplies, based on the 3% average annual GNP growth rate projected in the report for the period through 2000, will total approximately 3,026 million barrels oil equivalent (boe) in 1995 and reach about 3,170 million boe in 2000 -- for an annual growth rate of about 1% against 1986's level (about 2,749 million boe).

By energy source, oil supplies in 2000 are projected at 1,591 million barrels, accounting for 50.2% of total energy supplies. Thus even in the year 2000 oil is expected to supply more than 50% of Japan's energy needs, compared with about 56% today, remaining the major energy source for the nation.

JAPAN'S PRIMARY ENERGY SUPPLIES

		1985	1986	1995	2000
Oil	(bn bbl)	1.55 (56.3)	1.55 (56.3)	1.60 (52.8)	1.59 (50.2)
Hydropower	(mn kW)	34.34 (4.7)	35.70 (4.8)	41.30 (5.1)	44.30 (5.1)
Geothermal	(1000 kl)	460 (0.1)	460 (0.1)	740 (0.2)	910 (0.2)
Coal	(mn t)	110.94 (19.4)	106.00 (18.4)	100.00 (15.6)	107.00 (15.9)
Nuclear power	(mn kW)	24.69 (8.9)	25.85 (9.4)	42.80 (14.2)	53.30 (16.9)
Natural gas	(mn kl)	41.30 (9.5)	42.70 (9.8)	52.90 (11.0)	52.90 (10.5)
New energy forms, etc.	(mn kl)	5.00 (1.2)	5.40 (1.2)	5.80 (1.2)	6.30 (1.3)
Total	(bn bbl)	2.76 (100.0)	2.75 (100.0)	3.03 (100.0)	3.17 (100.0)

bn = billion; mn = million; boe = bbl oil equiv. ( ): % share

Among other energy sources, hydropower will supply a projected 44.3 million kW in the year 2000, accounting for 5.4% of all energy needs; geothermal energy, 910,000 kl for 0.2%; coal, 107 million tons for 15.9%; nuclear power, 53.3 million kW for 16.9%; natural gas, 52.9 million kl for 10.5%; and new energy forms, 6.3 million kl for 1.3%. Nuclear power is projected to post a significant gain in its percentage contribution to total energy supplies.

The report also offers projections for Japanese domestic demand for petroleum products. While gasoline, diesel oil and jet fuel will increase toward the year 2000, though at modest rates, kerosene and fuel oil, products that will face increasing competition with other energy sources, are expected to decline slightly. Accordingly, domestic demand for petroleum products as a whole is projected to register an average annual growth rate of 0.1% between 1986 and 2000, thus remaining virtually flat through the turn of the century.

/13046
CSO: 4307/037

OVERVIEW OF 1987 MOONLIGHT PROJECT

Tokyo JITA NYUSU in Japanese Mar 87 pp 11-13

[Article by Moonlight Project Promotion Office of the Agency of Industrial Science and Technology]

[Text] The Moonlight Project was established in FY 1978 by the Agency of Industrial Science and Technology of the Ministry of International Trade and Industry to promote the comprehensive and planned research and development of energy-conservation technologies encompassing the industry, academia and national research institutes. So far, the research and development have produced a number of concrete results including an absorption heat pump system and a waste-heat recycling system that is used in factories, etc. both domestic and overseas.

Even though the recent supply and demand trends for oil have been favorable, mid-range forecasts predict demand for oil to steadily increase, fueled by a strong demand by developing countries. Some predict a tighter supply and demand situation for oil in the 1990's. Whatever, aggressive energy conservation efforts must be continued, and among energy conservation efforts, the development of energy-conservation technologies is very important because they not only reduce the cost of imported energy but also activate the social and industrial activities by reducing the energy spent for transportation, industrial activities and civilian activities.

Described below is an overview of the individual projects for FY 1987.

1. Large Energy-Conservation R&D Projects

Those energy-conservation technology R&D projects that cannot be carried out by private industry because of cost or time constraints are undertaken as joint R&D projects involving the national research institutes, private industry, academia, etc. The following five projects are currently underway. Two projects--waste-heat usage technology and magnetohydrodynamic (MHD) power generation--have been concluded with satisfactory results.

(1) High-Efficiency Gas Turbine

The objective is to achieve a total thermal efficiency of 55 percent (LHV equivalent) by developing a high-efficiency gas turbine and combining it with a steam turbine generator in a combined generation system.

FY 1987 is the final year of this project. The results of the operation of a 100,000-kw output pilot plant (total thermal efficiency of 50 percent; LHV) will be analyzed. High-temperature parts will be disassembled and inspected, and the results will be used for analyzing the performance of the pilot plant. At the same time, to evaluate the performance of turbine blades and combustion chambers exposed to a turbine inlet temperature of 1,400°C, high-temperature, high-speed turbine testers composed of major gas turbine components will be tested. The basic design of the prototype plant will conclude after proving a combined generation efficiency of 55 percent or more.

(2) New Battery Power Storage System

The objective of this project is to develop a new large-capacity high-performance battery so as to develop a power storage system capable of storing electrical power during off-peak night hours and releasing the stored power during peak daytime hours so as to level the load on the system.

Research and development during FY 1987 will be devoted to the establishment of modular technologies that are required for the construction of a pilot plant. This will consist of optimization of module configuration, improving reliability and safety, reducing cost, etc. which are required for developing 60 kw-class module batteries which will be used as the building blocks for a new 1,000-kw-class battery. System tests of the power system will be continued to collect and analyze data on operation characteristics, high-harmonics properties, etc. The purpose will be to study the optimum method for controlling the operation of a power storage system that is expected to be linked to the power system.

(3) Fuel Cell Power Generation Technology

This is a power generation technology that promises to deliver a total efficiency of as high as 80 percent if natural gas, methanol, coal gas, etc. are used as a fuel and waste-heat is effectively used. It can also be used for co-generation. This project will develop a power generation system that may be used as an alternative for thermal power generation, distributed power generation as well as on-site power generation.

Research into phosphoric acid fuel cells during FY 1987 will consist of a study of the operation of low-temperature low-pressure and high-temperature high-pressure 1,000-kw power generation plants to establish the operation know-how and to understand the plant's operation characteristics. Dismantling inspection will be performed to evaluate the long-term characteristics of the plants. Development of a similar on-site 200-kw plant will consist of system design and the development of the component technologies. As for molten carbonate fuel cells, we will begin the development of the stack element technologies. Research into solid electrolyte fuel cells will consist of the development of the elemental and material technologies.

(4) General-Purpose Stirling Engine

A Stirling engine, if ideally operated, is an external combustion engine capable of achieving the highest thermal efficiency among heat engines.

Stirling engines are expected to provide a higher thermal efficiency than gasoline engines and other internal combustion engines. The absence of an explosion cycle means minimal engine vibration and noise. The objective of this project is to perform R&D on 3-kw-class and 30-kw-class Stirling engines that can be used as a compact power source and as a drive source for heating/cooling heat pumps.

FY 1987 is the final year of the R&D project. Efforts will be focused on improving the durability and reliability and reducing the size of the engines that have been developed. We will also improve the design of a system that is connected to a real load, such as an engine or a heat pump, create prototypes of such systems and perform a final evaluation.

(5) Superheat Pump/Energy Storage System

The objective of this project is to develop a compact, energy storage system by combining a superheat pump with an efficiency that is twice as high as that of conventional heat pumps and a chemical reaction that, during night, stores surplus energy at a high density and that releases the energy when required as heat or cold.

FY 1987 will be devoted for developing component technologies, such as very-high-performance compression heat pumps, and starting a prototypical operation of a 100-kw and 10,000 kcal-class bench plants.

2. Research and Development of Leading Fundamental Energy-Conservation Technologies

The research institutes of the Agency of Industrial Science and Technology will perform research and development on system technologies incorporating various elemental technologies to be applied in new areas, technologies to serve as seeds for the development of future energy-conservation technologies, fundamental technologies, etc., which are not easily developed by private industry.

For FY 1987, the following 10 topics will be researched: superconductive power equipment, potassium turbine technology, latent heat storage technology, energy conservation in graphitization, energy conservation in production of high-melting-point inorganic compounds, technology for measuring the thermal properties of high-temperature materials, high-efficiency motive power conservation technology using reheat cycle, complex reaction vessels equipped with highly functional separation membrane, coal fuel MHD power generation and sophistication of fuel technology.

3. Study for Establishment of Energy Conservation Technologies

The relationship between energy-conservation technologies and fundamental technologies will be clarified to develop energy conservation technologies. A comprehensive evaluation will be performed to establish methods for understanding the overall effects. A study is being conducted on the technical benefits, economical feasibility, etc. of specific energy-conservation technology development topics. The feasibility study initiated

in FY 1986 on superconductive power generation-related equipment/material technology and the use of coal gas in the coming generation of high-efficiency power generation systems will be continued in FY 1987.

4. Assistance to Private Sector Research and Development on Energy-Conservation Technologies

The objective is to use the Energy-Conservation Technology R&D Subsidy and the Petroleum Alternate Energy Technology Implementation and Development Subsidy to enable the smooth research and development of energy-conservation development projects undertake by the private industry which are particularly important.

During FY 1987, assistance will be provided to such projects as the energy conservation technology for energy-consuming equipment and heat pump air conditioners for cold climate areas.

5. Promoting Energy Conservation Through Standardization

The objective is to establish or revise the Japanese Industrial Standards (JIS) and use the JIS mark display system to promote energy conservation.

During FY 1987, standards will be developed, and research and investigation will be conducted on the standardization of the combustion performance of energy-conservation gas combustion equipment. Additionally, research and investigation for the standardization of energy-conserving construction materials, fixtures, etc. will be continued as required for promoting energy-conservation standardization.

6. International Cooperation for Energy Conservation

The objective is to take part in bilateral R&D projects with specific nations and to participate in the energy conservation-related R&D projects overseen by the International Energy Agency (IEA) by undertaking specific R&D projects.

As for the IEA, Japan, which is a participant in a treaty to implement improved heat pump systems, is promoting R&D efforts based on this treaty. as for bilateral cooperation, Japan and France are holding regular meetings among specialists.

Such cooperative efforts will be aggressively promoted in FY 1987.

FY 1987 Moonlight Project-Related Budget

(Unit: million yen)

Item	FY 86 budget	FY 87 budget	Overview of FY 87 project
1. Large energy-conservation technology	11,815 653 [11,162]	10,671 476 [10,195]	
(1) High-efficiency gas turbine	1,880 53 [1,827]	757 54 [703]	The results of past development of materials and elements, pilot plants and secondary high-temperature high-speed turbine tests (HTDU) tests) will be consolidated to implement a 1,400°C class tertiary HTDU test to check the overall thermal efficiency of combined generation plants.
(2) New battery power storage system	3,170 146 [3,024]	2,205 77 [2,128]	We will start research on a tech nology for increasing the size of new batteries so as to produce a 1,000-kw-class new battery power storage system pilot plant. We will also continue testing 1,000-kw-class system tests using sample batteries.
(3) Fuel cell power generation technology	3,190 129 [3,060]	3,383 113 [3,270]	We will operate and dismantle a high-temperature high-pressure type and a low-temperature low-pressure type 1,000-kw-class plants relevant to phosphoric acid fuel cells. We will also conduct a comprehensive technical development of 200-kw-class on-site power generation plants. We will start the development of stack technology for molten carbonate fuel cells. We will continue the fundamental research in solid electrolyte fuel cells.
(4) General-purpose Stirling engine	2,231 170 [2,060]	2,017 60 [1,957]	We will operate and conduct research into four types of prototype 3-kw and 30-kw engines and systems using such engines.

[continued]

[Continuation of FY 1987 Moonlight Project-Related Budget]

Item	FY 86 budget	FY 87 budget	Overview of FY 87 project
[(4) continued]			We will also conduct research on the diversification of fuel sources. These results will be used as a basis for a final evaluation.
(5) Superheat pump/energy integration system	1,345 154 [1,190]	2,310 173 [2,136]	We will use the results of research into the elemental technologies of very-high-performance compression heat pumps and chemical heat storage technology to design and build bench plants. We will also concentrate on systematization and development of total systems.
2. Leading fundamental energy-conservation technologies	195	172	Ten topics including potassium turbine technology, coal combustion MHD power generation, and superconductive power equipment will be researched.
3. International research cooperation	25	27	We will continue to participate in the IEA's improved heat pump implementation treaty Annex IV and will also participate in the new Annex. We will also promote bilateral (Japan-France, etc.) projects.
4. Establishment and study of energy-conservation technologies (1) Establishment of methods for evaluating the overall effects (2) Superconductive power generation related equipment, etc. FS	88 8 [80]	151 7 [144]	We will develop energy-conservation related technical topics and study the establishment of optimum R&D methods. Specific topics include the continuation of feasibility studies regarding superconductive power generation related equipment/material technology and the use of coal gas for next-generation efficient power generation systems.

[Continuation of FY 1987 Moonlight Project-Related Budget]

Item	FY 86 budget	FY 87 budget	Overview of FY 87 project
5. Assistance to private sector energy-conservation technology development	68	44	To provide assistance to energy-conservation technology related R&D conducted by the private sector.
6. Energy-conservation standardization	23	22	To conduct research on the development of energy-conservation standards for construction material and consumer equipment.
7. Others	57 54 [3]	317 11 [306]	Clerical expenses required for R&D, cost of removal of high-efficiency gas turbine facilities, etc.
Subtotal	12,271 1,026 [11,245]	11,404 760 [10,644]	
8. Assistance to development of consumer equipment	55	75	To development of consumer equipment (heat pump air conditioner for cold climate areas).
Total	12,326 1,026 [11,300]	11,479 760 [10,719]	

[ ]: Top row: general account
Bottom row: special account
General account when only one figure is shown.

13386/9365
CSO: 4306/2048

MERIT OF HADAMARD TRANSFORM ACTIVE ABSORPTION SPECTROMETER DESCRIBED

Tokyo IBARAKI BUNKO KENKYU in Japanese No 2 Vol 36, Feb 87 pp 112-122

[Article by Nobuo Sugimoto of the National Institute for Environmental Studies, Yatabe, Tsukuba: "Hadamard Transform Active, Long-Path Absorption Spectrometer System for Monitoring Atmospheric Trace Gases: Laboratory Experiments and Estimation of the Sensitivity"]

[Text] The merit of the Hadamard transform active long-path absorption spectrometer was demonstrated by laboratory experiments. The dependence of measurement errors on modulation codes was investigated. The spectral resolution of a spectrometer system and the deformation of the spectrum were tested. The sensitivity of the NO_3 measurement in the 660-nm region was estimated for a system suing high intensity LEDs and a room temperature photodiode array. The effect of the ghost of the Hadamard transform due to the nonlinearity of the detector and a method to correct the ghost are discussed.

1. Introduction

Detection of molecules that occur in trace amounts in the atmosphere is essential to elucidation of the mechanism of atmospheric chemical reactions and to our understanding of the relationship between human activities and the atmospheric environment. The ultraviolet and visible region differential optical absorption spectroscopy (DOAS) methods developed by Platt afford promising means of measuring trace gases in the atmosphere with a high degree of sensitivity. To date Platt and his colleagues have reported measurements of CH_2O, O_3, SO_2, NO_2, NO_3, and HONO.[1-4] The apparatus developed by Platt, et al. uses a diffraction grating spectrometer equipped with a white-light source and a high-speed scanner to measure atmospheric absorption spectra over a light path about 1 km long. Previously this author and his colleagues proposed a new system using Hadamard transform optics as a means of improving the sensitivity of long-path light absorption measurements.[5,6] This system, as shown in Figure 1, uses an array of several LEDs as the light source, and also uses an array sensor as the spectrometer detector. The LED array is directly modulated by means of a Hadamard matrix code. A characteristic of this system is the fact that in principle it uses the Hadamard transform on the input side and an array sensor on the output side. Although the system is equivalent to the Hadamard transform spectrometer, it uses no mechanical masks. The system has achieved a substantial improvement in the S/N ratio

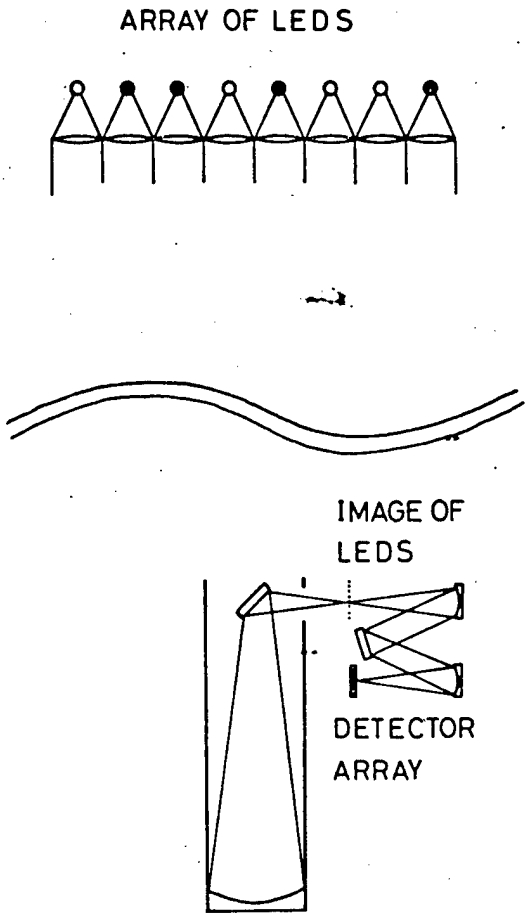


Figure 1. Schematic Diagram of the Hadamard Transform Active Long-Path Absorption Spectrometer System

over conventional long-path absorption spectrometer systems. This paper reports on basic experiments using the Hadamard transform positive long-path spectrometer system and presents an evaluation of the measurement sensitivity of the system.

2. Hadamard Transform Optics

Since the optics of the Hadamard transform are discussed in detail in the monograph by Harwit and Sloane,[7] in the following we will consider examples of Hadamard transform applications to actual long-path spectrometer systems.

The system depicted in Figure 1 uses the Hadamard transform as a means of distinguishing light emissions from the individual LEDs which are light source array elements. By way of illustration of the advantages of Hadamard transform, let us consider the determination of one-dimensional distribution of transmissivity of a sample placed between the light source LED array and the detector. The determination can be made by either of two ways: by turning the LEDs on and off one by one to determine the transmissivity distribution (scanning), and by Hadamard transform. The Hadamard transform

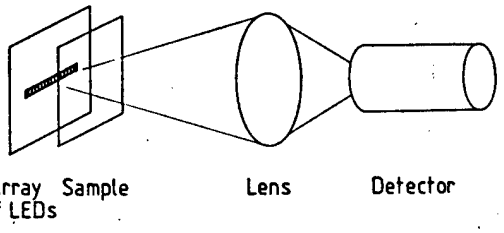


Figure 2. Schematic Diagram of the Simple Experiment of the Hadamard Transform Optics

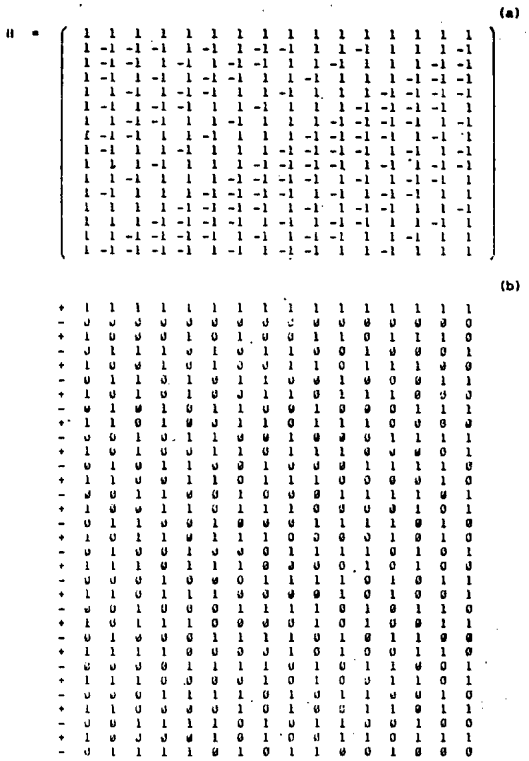


Figure 3. Example of the Hadamard Matrix and the Corresponding Code for Modulation

method records signals by modulating the LEDs through the use of a code, such as the Hadamard code shown in Figure 3(b). After a period of measurements is completed, the intensity of signals due to individual LEDs can be obtained by inverse transformation of the Hadamard matrix which was used to modulate the recorded signals.

Figure 3(a) shows an example of a Hadamard matrix of degree 16 which is a symmetric orthogonal matrix, i.e., the following relationship holds between the elements of the matrix:

$$a_{ij}=a_{ji}$$

$$\sum_j a_{il}a_{ij}=\begin{cases} N & l=j \\ 0 & l\neq j \end{cases} \qquad (1)$$

The Hadamard transform uses this matrix to modulate the individual LEDs in the light source. However, since in actuality light cannot be modulated by using codes 1 and -1, the modulation by the matrix shown in Figure 3(a) is accomplished by using the difference between two measurements by codes consisting of 1 and 0 as one modulation step. Signals encoded in this manner can be expressed by the following formula:

$$\begin{aligned} y_i &= y_i^{(1)} - y_i^{(2)} \\ &= \sum_j b_{ij} I_j - \sum_j c_{ij} I_j \\ &= \sum_j a_{ij} I_j \end{aligned} \tag{2}$$

where y_i represents the i-th step signal during modulation, and b_{ij} and c_{ij}, respectively, represent swapping -1 and 0 in the matrix in Figure 3(a) and replacement of 1 with 0 and -1 with 1. Further, I_j represents the intensity of light from the j-th LED, i.e, the intensity of the j-th LED multiplied by the transmissivity of the sample at that position.

Taking advantage of the orthogonality of the Hadamard matrix, I_j can be obtained from a set of encoded signal y_i by using the following formula:

$$\begin{aligned} S_i &= \sum_i a_{ii} y_i \\ &= \sum_i \sum_j a_{ii} a_{ij} I_j = N I_i \end{aligned} \tag{3}$$

where N=16 for this particular case.

In addition to the code shown in Figure 3, the matrix shown in Figure 4, a periodic S matrix comprised of elements 1 and 0, can be used. Although this is not an orthogonal matrix, the following relationship holds between this matrix and the matrix generated by replacing 0's in this matrix with -1's:

$$\sum_i a_{ii} a_{ij} = \begin{cases} \dfrac{N+1}{2} & l = i \\ 0 & l \neq i \end{cases} \tag{4}$$

$$S = \begin{pmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{pmatrix}$$

Figure 4. Example of the Cyclic S-Matrix Used for the Hadamard Transform

Since this matrix is comprised of elements 0 and 1, a set of measurements (N=16 in this case) can be accomplished by N measurements. This matrix is used in conventional Hadamard spectrometers using masks.[7] However, as will be shown later, the matrix shown in Figure 3 is more advantageous if the light source is to be transformed directly.

Next, let us consider a comparison of SN ratios. In the scanning method, an SN ratio ([an observed value]/[standard deviation of observed values]) can be expressed by the following formula:

$$\frac{S}{N}=\frac{I_i}{((1/\xi)I_i+\theta^2+(1/\xi)B)^{1/2}} \tag{5}$$

where ξ is a constant to convert light energy to the number of photons, as follows:

$$\xi=\eta_0 \Delta t/h\nu \tag{6}$$

Δt denotes the amount of time required for measurement of one step. Also, θ in equation (5) denotes a power equivalent to noise from the detector, and B denotes the intensity of background light.

For a Hadamard transform using the code shown in Figure 3 (hereinafter referred to as Hadamard Transform I), the S/N ratio can be obtained as follows. First, the error in encoded signal y_i is expressed by:

$$E[(\Delta y_i)^2]=(1/\xi)(y_i^{(1)}+y_i^{(2)})+2\theta_i^2+2(1/\xi)B \tag{7}$$

where E[ ] denotes the average value of many sets of measurements carried out repeatedly. This symbol is omitted on the right-hand side of the above equation. The error relative to S_1 obtained by inverse transformation will be as follows:

$$\begin{aligned} E[(\Delta S_i)^2] &= E[\sum_i \sum_j a_{ij}a_{ij}\Delta y_i \Delta y_j] \\ &= E[\sum_i (\Delta y_i)^2] \\ &= (1/\xi)N\sum_j I_j+2\theta_i^2+2(1/\xi)B \end{aligned} \tag{8}$$

where for i not equal to j it is assumed that no correlation exists between Δy_i and Δy_j. Equation 8 allows us to express the measured SN ratio by the following formula:

$$\begin{aligned} \frac{S}{N} &= \frac{E[S_i]}{((E[\Delta S_i)^2])^{1/2}} \\ &= \frac{NI_i}{((1/\xi)N\sum_j I_j+2N\theta_i^2+2N(1/\xi)B)^{1/2}} \end{aligned} \tag{9}$$

If the periodic Hadamard matrix comprised of elements 1 and 0 (hereinafter referred to as Hadamard Transform II) shown in Figure 4 is used, the SN ratio can be obtained by similar procedures as follows:

$$\frac{S}{N}=\frac{((N+1)/2)I_i}{(((N+1)/2)(1/\xi)\sum_j I_j+N\theta_i^2+N(1/\xi)B)^{1/2}} \tag{10}$$

Since both the scanning method and the Hadamard Transform II result in measurement values which contain background light and the direct current components of detector noise, to remove these factors it is necessary to carry out zero-level measurements. Table 1 shows SN ratios measured for the same

Table 1. Signal-To-Noise Ratio ([mean]/[deviation]) of the Measurement

Method	Error Source: Photon Noise	Error Source: Detector Noise	Error Source: Background Photon Noise	Base Line Shift Caused by B	Base Line Shift Caused by θ_0
(a) Scan	$\frac{I_i}{\sqrt{(1/\xi)\bar{I}_i}}$	$\frac{I_i}{\theta}$	$\frac{I_i}{\sqrt{(1/\xi)B}}$	B	θ_0
(b) Hadamard I	$\frac{I_i}{\sqrt{2(1/\xi)\bar{I}}}$	$\frac{\sqrt{N}I_i}{2\theta}$	$\frac{\sqrt{N}I_i}{2\sqrt{(1/\xi)B}}$	0	0
(c) Hadamard II	$\frac{\sqrt{N+1}\,I_i}{\sqrt{2N(1/\xi)\bar{I}}}$	$\frac{(N+1)I_i}{2\sqrt{N}}$	$\frac{(N+1)I_i}{2\sqrt{N(1/\xi)B}}$	$\frac{2B}{N+1}$	$\frac{2\theta_0}{N+1}$
(d) Scan+Zelo Level Meas.	$\frac{I_i}{\sqrt{2(1/\xi)\bar{I}_i}}$	$\frac{I_i}{2\theta}$	$\frac{I_i}{2\sqrt{(1/\xi)B}}$	0	0
(e) Hadamard II+Zero Level Meas.	$\frac{\sqrt{N+1}\,I_i}{2\sqrt{N(1/\xi)\bar{I}}}$	$\frac{(N+1)I_i}{4\sqrt{N}\theta}$	$\frac{(N+1)I_i}{4\sqrt{N(1/\xi)B}}$	0	0

amount of time, including zero-level measurements. In this table, the SN ratios are compared in terms of whether the error limiting the SN ratio stems from photon noise, thermal noise, or background light noise. The table clearly indicates that, compared to the scanning method, the Hadamard transform gives higher SN ratios of those parts of an I_j pattern where I_j is greater than i and lower SN ratios where I_j is less than I. In cases where thermal noise and background light noise are the limiting factors, the Hadamard Transform I (Table 1(b)) gives an SN ratio which is higher than one produced by the scanning method (Table 1(d)), by the square root of N. The Hadamard Transform II method (Table 1 (e)), on the other hand, gives an SN ratio which is half of what is produced by the Hadamard Transform I method (Table (b)).

3. Experiments and Discussion

To verify the advantages of the Hadamard transform, experiments were carried out by using the apparatus shown in Figure 2. The light source used consisted of 16 display-purpose small LEDs fitted on a base plate. The LEDs were driven by a minicomputer (a NOVAC machine) via parallel interface. A photomultiplier was used as a detector. Signals were fed into the minicomputer via an ad converter. The data were analyzed on an offline basis after being recorded on magnetic tape.

Figure 5 shows transmitted light patterns measured by the scanning method (including zero-level measurements), Hadamard Transform I, and Hadamard Transform II (including zero-level measurements) for photon noise-limited cases. A filter was placed before elements 7 through 10 of the light source. Both the scanning and Hadamard Transform I methods had about the same degree of measurement errors, the difference being that in the scanning method the errors were proportional to one-half of the element intensities, whereas in the Hadamard transform all segments had about the same size of error. A comparison between the Hadamard Transforms I and II indicates that the Hadamard Transform I gives an SN ratio which is higher by about the square root of 2, a result consistent with the theoretical values shown in Table 1.

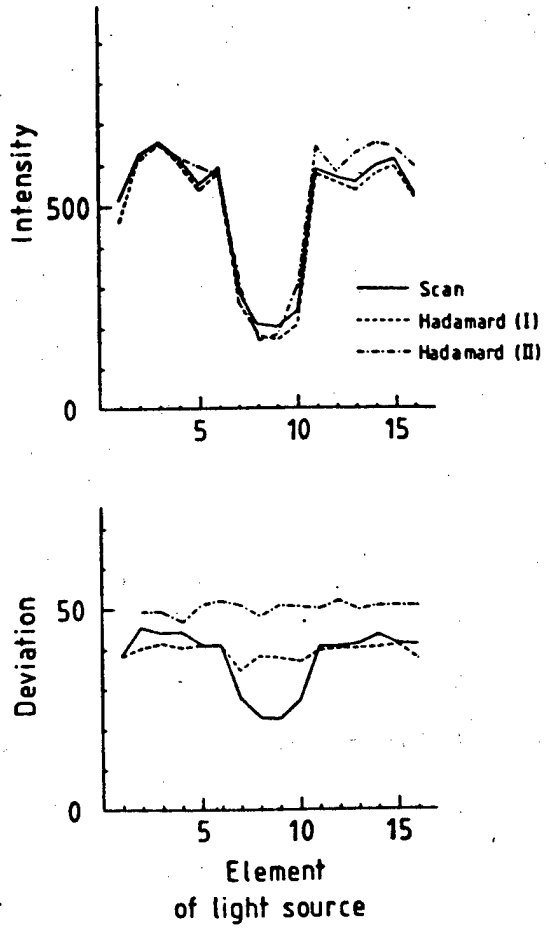


Figure 5. Transmission Pattern of a Filter. The signal intensity and the deviation are shown for the scan method, the Hadamard Transform I method, and the Hadamard Transform II method. The photon noise limiting case.

Figure 6 shows experimental results obtained by increasing the level of background light. In this case, the error of measurement under the Hadamard Transform I is $1/\sqrt{16}$ that under the scanning method. The magnitude of error under the Hadamard Transform II is approximately twice that under the Hadamard Transform I, which is also consistent with the results of Table 1.

To determine the effect of atmospheric fluctuations which could pose a problem in actual long-path determinations in the atmosphere, we carried out similar measurements by causing all LED output to vary periodically. The results are shown in Figure 7. The measurements were carried out in such a way that the variation in the intensity of LEDs will be approximately one-third of the period so that it will not coincide with the modulation periods. The background light was set to zero. The fine dotted lines in Figure 7 represent a correction to the signal intensities, by taking advantage of the fact that the sum of two determinations corresponding to the code 1 step shown in Figure 3(b) and obtained during Hadamard Transform I determinations is constant. The correction served to dampen errors. The error of measurement

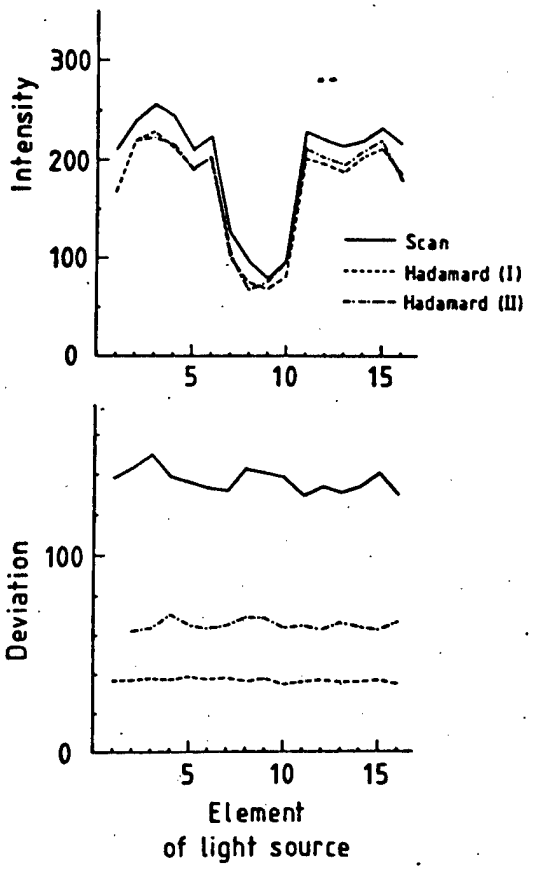


Figure 6. Transmission Pattern of a filter. The signal intensity and the deviation are shown for the scan method, the Hadamard Transform I method, and the Hadamard Transform II method. The background noise limiting case.

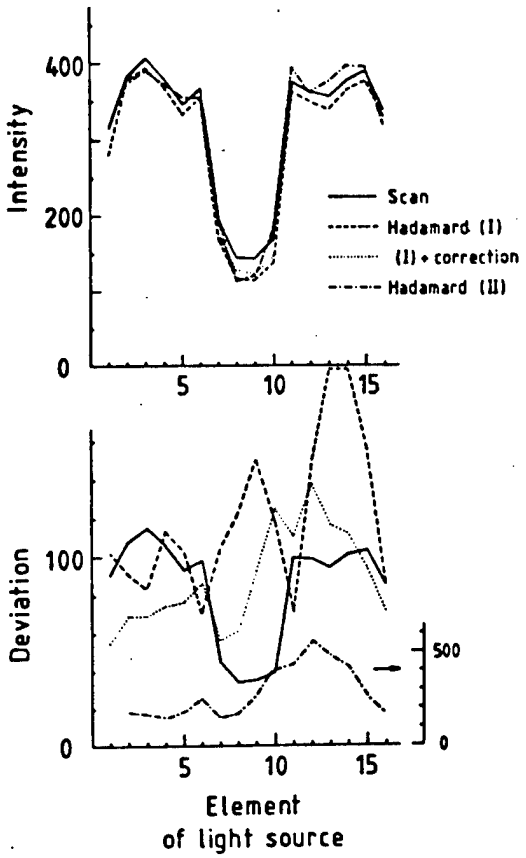


Figure 7. Transmission Pattern of a filter. The intensity of the light source was modulated to simulate the fluctuation of the atmospheric transmittance. The signal intensity and the deviation are shown for the scan method, the Hadamard Transform I method, the Hadamard Transform II method, and the Hadamard Transform I method with the correction.

associated with the Hadamard Transform I method, corrected by this method, was about the same as the error of measurement in the scanning method. On the other hand, the Hadamard Transform II method, being sensitive to atmospheric fluctuations, is not appropriate for long-path spectrometric measurements. The experiments carried out led to the conclusion that even when the Hadamard transform is used, to avoid the influence of atmospheric fluctuations the measurements for each period must be carried out sufficiently faster than the atmospheric fluctuations, as in the case of the scanning method.

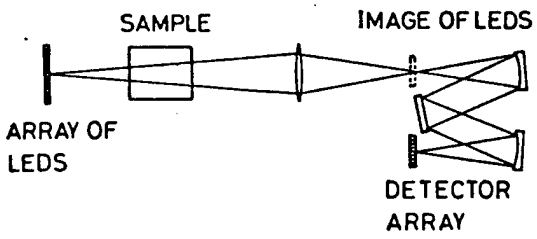


Figure 8. Schematic Diagram of the Hadamard Transform Spectrometer Used for the Laboratory Experiment

Now let us turn our attention to the experiment conducted by using the apparatus shown in Figure 8, with the objective of gathering basic experimental data relating to the Hadamard transform long-path spectrometer. Basically this apparatus is equivalent to the one shown in Figure 1. The purpose of the experiment was to improve the SN ratio associated with Hadamard transform-based spectrometric determinations and to evaluate spectral resolution as well as spectral distortions. The spectrometer used had a focal distance of 25 cm (Nippon Bunko CT25C), the detector was a photodiode array (Reticon RL1024G). The video signals emanating form the photodiode array were collected into a minicomputer by means of a peak-hold circuit and a transient recorder (Iwatsu DM901). The LED consisted of 16 small-scale display-purpose LEDs arranged in a regular pattern. The size of an image on the spectrometer incident surface was 4 mm for the 16 LEDs, i.e., each LED image had a size of 250 microns. The resolution of the spectrometer shown in Figure 8 was predicated on either this size or the size of an array sensor segment, whichever would be larger. In the present example, the resolution corresponding to the LED image size is approximately 0.8 nm. Since the position of an image on the incident surface of the spectrometer varies from one light source element to another, the spectral position obtained on the array sensor also shifts somewhat according to this fact.

Figure 9 shows transmission spectral measurements obtained by placing a band filter (central wavelength: 700 nm) as a sample. The left-hand size of the figure indicates spectral measurements obtained by turning the LEDs on and off one by one (scanning method). The numbers shown in the figure represent individual light source elements. The horizontal axis corresponds to the diode array segments. The array sensor used in this experiment consisted of 1,024 elements, with an interelement distance of 25 μm. Because of the large volume of data that must be dealt with, the average of data for 16 elements was treated as one channel for data processing purposes. Figure 9 indicates that the spectral wavelength axes due to each element in the light source shift gradually according to the position of an image on the incident surface.

Figure 9 indicates the same measurements carried out by using the Hadamard Transform I. As in the case of the left side of Figure 9, the numbers shown in the figure represent individual light source elements. The same amount of time was required for these measurements as for the measurements shown in the left side of the figure. In the photodiode array used in these measurements (at room temperature), the noise from the detector was dominant even in this

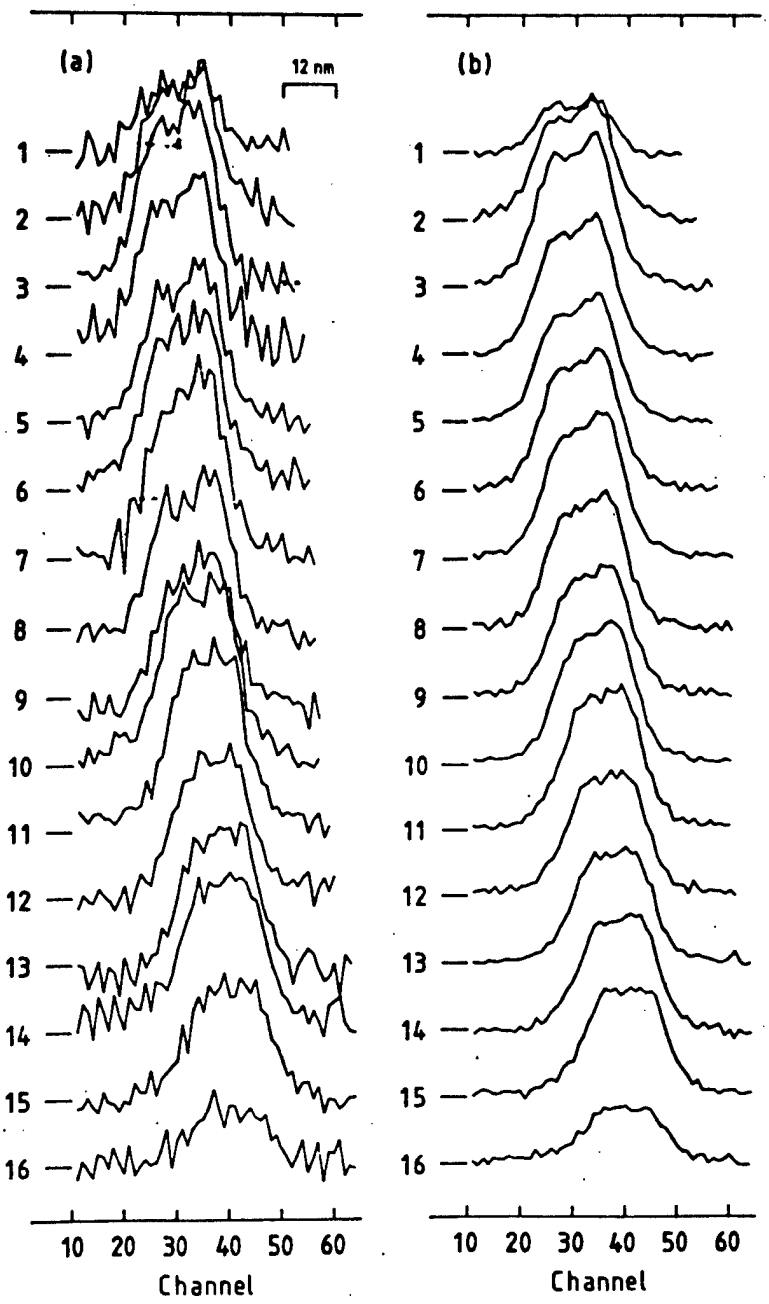


Figure 9. Transmission Spectrum of a Bandpass Filter: (a) Measured by the Scan Method; (b) Measured by the Hadamard Transform I Method.

wavelength region. consequently, the Hadamard transform had an approximately four times greater SN ratio of measurements than did the scanning method.

The Hadamard transform spectrometer shown in Figure 8 is capable of simultaneous measurement of absorption spectral spatial distribution. However, since application to long-path spectrometer measurements involves the measurement of absorption spectra only, the purpose is to improve the SN ratio by correcting the shift along the wavelength axis of the spectra shown on the right side of Figure 9. The procedures required to accomplish this purpose are described below.

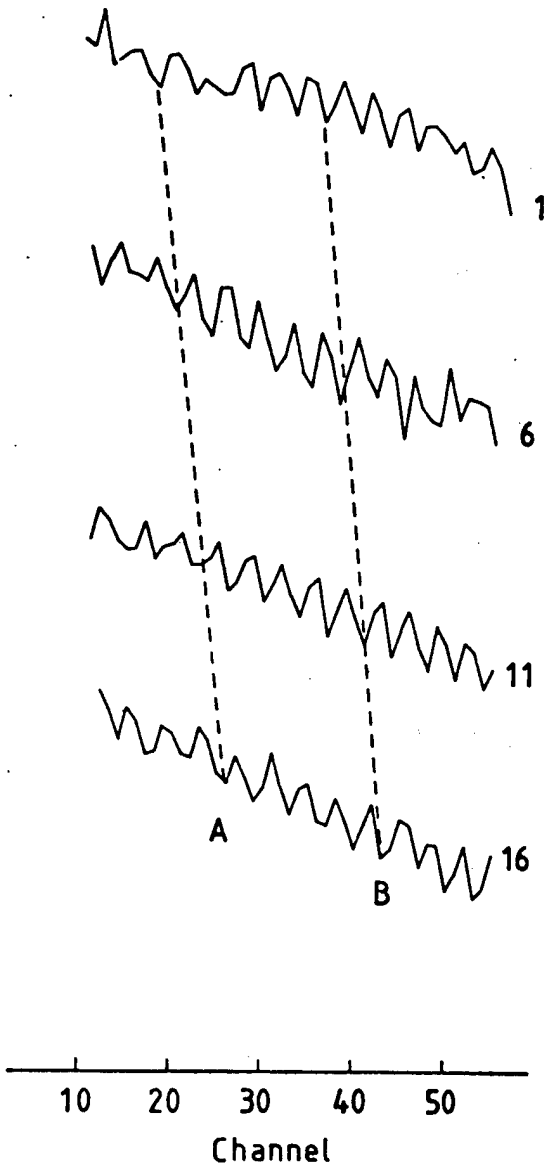


Figure 10. Transmittance of I_2 Measured by the Hadamard transform method. The spectrum of the elements 1, 6, 11, and 16 are shown. The broken lines show the shift of the vibrational structure on the array sensor.

To measure accurately the shift along the wavelength axis of spectra from the individual LEDs, the absorption spectra of I_2 were measured first. Figure 10 shows the transmission spectra of I_2 measured by means of the Hadamard Transform I. The transmission spectra obtained by dividing the measured values by the emission spectra of I_2 are shown. The figure shows spectra produced by LEDs 1, 6, 11, and 16. The broken lines indicate the shifts of specific vibration band positions on the array sensors. Figure 11 is a plot of the shifts, using the light source elements numbers as the horizontal axis and the channel numbers of array sensors in which specific vibration bands

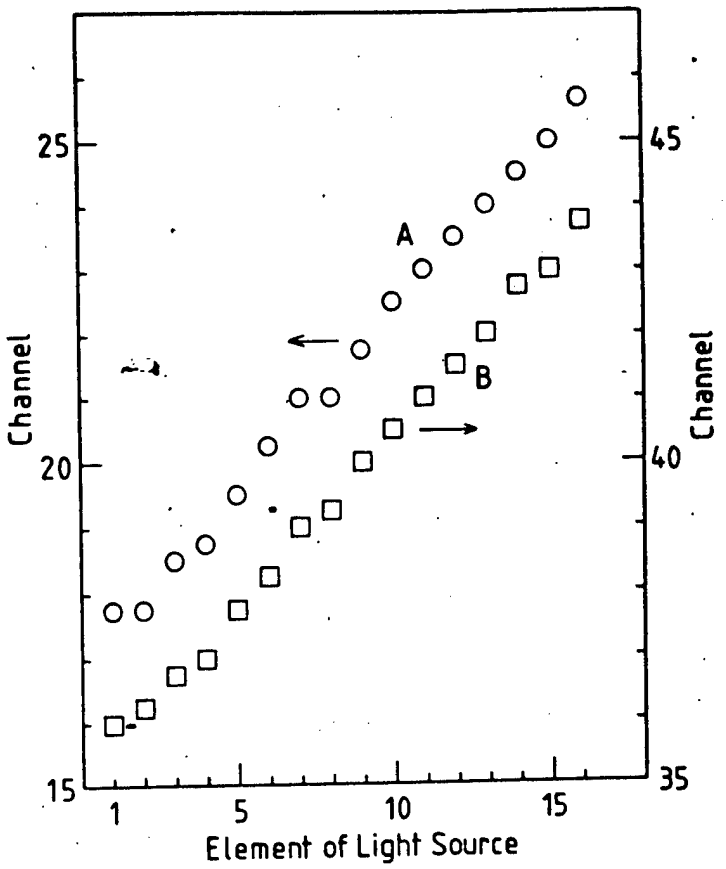


Figure 11. The Position of the Vibrational Band A and B on the Array Sensor as a Function of the Element Number of the Light Source

appear as the vertical axis. Spectral positions shift in a straight line. This fact indicates that the spectral distortions due to a difference in the position of incident light image are less than the spectral resolution and can be ignored.

Figure 12 shows the average of spectral wavelength axes obtained by deriving the relationship between light source elements and the wavelength shift by using the least square method from Figure 11.

Now, let us turn our attention to experimental results relating to the measurement sensitivity of the Hadamard transform active long-path spectrometer system. One of the wavelength regions on which the Hadamard transform long-path spectrometer method works most effectively is considered to be the 1-2 μm region.[5,6] However, the currently available array sensors capable of handling this wavelength region are quite expensive. Therefore, the purpose of this study we consider the long-path spectrometer measurement system in the 660 nm band designed to measure NO_3. Table 2 gives the specifications for the conceived system. A high-intensity LED (3,000 mCd) was used as the light source. Table 3 shows the result of evaluation of errors in long-path spectrometer measurements using the small system (Figure 8) designed so that the efficiencies of that system and the optical system will match. Random errors, i.e., the standard deviation of measured values divided by the

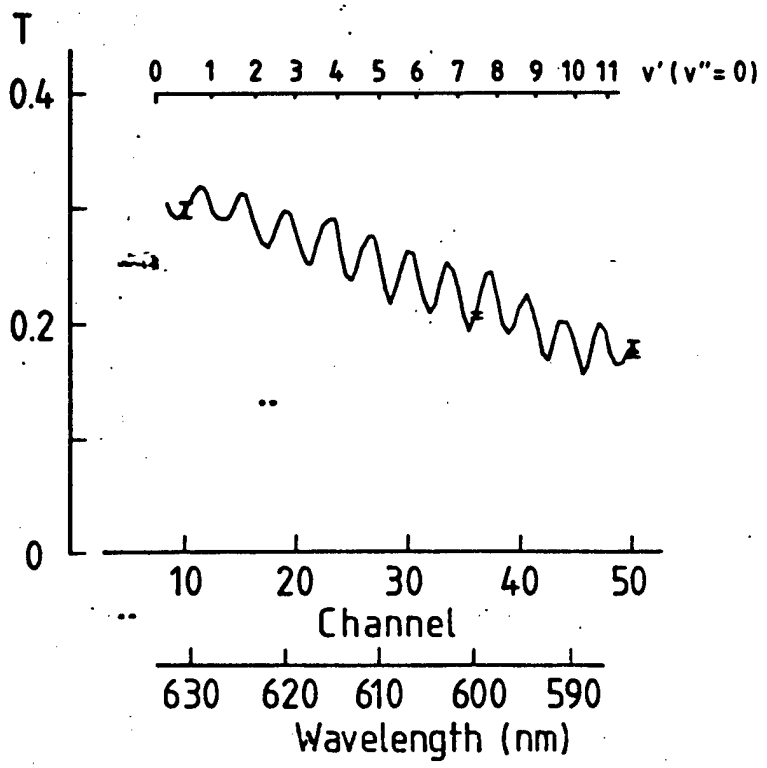


Figure 12. Transmittance of I_2 Measured by the Hadamard Method. The spectrum of all the elements were averaged after correcting the shift of the spectrum.

Table 2. Specification of the Hadamard Transform Active Long-Path Absorption Spectrometer System for the NO_3 Measurement

Light Source	High Intensity Light Emitting Diode (Stanley H3000)×16	
	Wavelength	660-nm Region
	Intensity	3000 mCd
Transmitting Optics	Diameter	10 cm×16
	Focal Length	60 cm
Receiving Telescope	Diameter	20 cm
	Focal Length	1 m
Spectrometer	Focal Length	25 cm
	F Number	4.3
Detector	Photodiode Array (Reticon RL-1024G) or CCD Image Sensor (Matsushita NM8061A)	

average of the measured values reached 10^{-4} for measurements taken over a 20-minute period. The spectral resolution for the measurements was assumed to be 1.6 nm. since the differential absorption cross-section product for NO_3 at 660 nm is approximately 1.8 x $10^{-17}cm^2$,[4] the minimum detectable concentration of NO_3 at SN ratio 5 is approximately 10 parts per trillion.

In addition to the random errors there are systematic errors (ghost) attributable to incompleteness of the Hadamard transformation. Such errors,

Table 3. Errors in the Hadamard Transform Active Long-Path Absorption Spectrometer System for the NO_3 Measurements

	[error]/[signal]	Minimum Detectable NO_3 Concentration
Random Error[a)]	10^{-1}	10 ppt
Systematic Error[b)]	10^{-2}	—

a) 20-min measurement, resolution = 1.6 nm.
b) The ghost observed on an element when the light from the element is blocked.

analogous to crosstalk between light source element signals, do not present much of a problem of there are no strong absorption lines due to interfering substances in the spectral region to be measured. NO_3 measurements involve extremely weak absorption by water vapor in the same wavelength region. Therefore, it seems that these types of errors have little impact. However, these types of errors could be important in the application of Hadamard transform optics, as discussed below.

Systematic errors are considered to arise primarily from nonlinearity of the detector. Scanning-type array sensors produce a residual image, about 1 percent of the real image, even if the sensor is shut off after completion of exposure reading and before start of scanning. It has been determined that this causes the incompleteness of the Hadamard transform. Such a phenomenon was especially pronounced with CCD. In the case of a Hadamard transform using a Hadamard matrix of the type shown in Figure 3 (Hadamard Transform I is discussed in Chapter 2), the effects of residual images can be resolved by modifying the modulation code as follows: In the case of Hadamard Transform I, step 1 of modulation is the difference between two measurements of the code shown in Figure 3(b). The effects of residual images can be canceled by appropriately varying the order of these two measurements and by calculating the average of several measurements. Specifically, changing the order of measurement as shown in Figure 13 and by performing four periods worth of measurements, the effects of residual images from the one earlier step can be canceled. The numbers in the first row of Figure 13 represent the modulation step numbers; 0 and 1 indicate whether the measurements for a given step are to be performed in normal order or reverse order. In the example given, four periods comprise a set. Similarly, by combining 16 periods into one set it is possible to cancel the effects of residual images from 3 previous steps. Although this technique works well for the purpose of canceling residual image effects, the drawback is that it tends to prolong the time required to obtain a set of data, which means that long-path spectrometer measurements could be more liable to the effect of atmospheric fluctuations. Consequently, it is necessary to use a sensor that does not produce residual images.

The problem of incomplete Hadamard transform due to nonlinearity of the detector can be dealt with in the following manner. Consider the use of a Hadamard matrix of the type shown in Figure 3(b). Consider one of the array sensor channels. Let y_0 be the true signal to be input, and let y be the actual output from the sensor. y can be expanded as a polynomial of y_0 as follows:

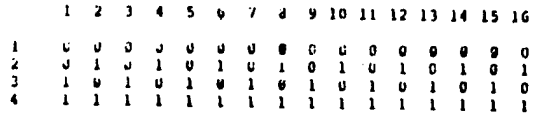


Figure 13. Explanation of the Method for Correcting the Effect of the Residual Images of the Array Sensor

$$v = v_0 + \gamma_2 v_0^2 + \gamma_3 v_0^3 + \cdots \tag{11}$$

The output of this signal from the sensor, encoded by the Hadamard transform method will be:

$$\begin{aligned} v_i &= v_i^{(1)} - v_i^{(2)} \\ &= [v_{0i}^{(1)} - v_{0i}^{(2)}] + \gamma_2[(v_{0i}^{(1)})^2 - (v_{0i}^{(2)})^2] \\ &\quad + \gamma_3[(v_{0i}^{(1)})^3 - (v_{0i}^{(2)})^3] + \cdots \\ &= [\sum_j b_{ij} I_j - \sum_j c_{ij} I_j] \\ &\quad + \gamma_2[(\sum_j b_{ij} I_j)^2 - (\sum_j c_{ij} I_j)^2] \\ &\quad + \gamma_3[(\sum_j b_{ij} I_j)^3 - (\sum_j c_{ij} I_j)^3] + \cdots \end{aligned} \tag{12}$$

where b_{ij} and c_{ij} are similar to the same used in equation (2). The signals in equation (12) are inverse-transformed as follows:

$$\begin{aligned} S_i &= \sum_j a_{ij} v_j \\ &= \sum_j (a_{ij} b_{ji} - a_{ij} c_{ji}) I_i \\ &\quad + \gamma_2 \sum_j a_{ij} (b_{ji} b_{jk} - c_{ji} c_{jk}) I_i I_k \\ &\quad + \gamma_3 \sum_j a_{ij} (b_{ji} b_{jk} b_{jm} - c_{ji} c_{jk} c_{jm}) I_i I_k I_m \\ &\quad + \cdots \end{aligned} \tag{13}$$

Thus, if the detector constants γ_2, γ_3, $\cdots$ are known, equation (13) can be used to evaluate the types of errors generated. Conversely if γ_2, γ_3, $\cdots$ are known, true S_i can be determined from experimentally determined S_i by using a successive approximation. In equation (13), the first term on the right-hand side in the second line represents true S_i, whereas the item on the left-hand side is experimentally measured S_i. Therefore, a first-degree correction term can be obtained by replacing I_i in the second and higher terms on the right-hand side with values (S_i/N) obtained from measured values. Using S_i corrected in this manner can be used to calculate a still further correction term. By repeating this procedure, one can obtain a value which approximates true S^i.

Carrying out such a correction procedure requires precise, prior determination γ_2, γ_3, $\cdots$. These coefficients, however, can also be obtained by using equation (13). Table 4 shows some of the second and third-degree terms of equation (13). The table indicates, for example, that the third-degree term

Table 4. Coefficients of the Second and Third Order Terms in Equation (13)

$\sum_j a_{ij}(b_{ji}b_{jk}-c_{ji}c_{jk})$

l	k	l=1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	3	8	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0
1	4	8	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0
.....																	
2	2	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	3	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0
2	4	0	8	0	8	0	0	0	0	0	0	0	0	0	0	0	0
.....																	

$\sum_j a_{ij}(b_{ji}b_{jk}b_{jm}-c_{ji}c_{jk}c_{jm})$

i	k	m	l=1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	1	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	2	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
.....																		
1	2	3	4	4	4	0	0	0	0	0	0	0	0	0	0	4	0	0
1	2	4	4	4	0	4	0	0	0	0	0	0	4	0	0	0	0	0
.....																		
2	2	2	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	2	3	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0
.....																		
2	3	4	0	4	4	4	0	0	0	0	4	0	0	0	0	0	0	0
2	3	5	0	4	4	0	4	0	4	0	0	0	0	0	0	0	0	0
.....																		
2	4	6	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	4
.....																		

causes ghosts in four elements. If only I_1, I_2, and I_3 are non-zero, a ghost is generated in S_{14} which is supposed to be zero. Consequently, if it is possible to regard the fourth and higher degree coefficients as being zero, γ_3 can be obtained from the above procedure. γ_2 can be obtained through the same procedure, by considering the cases where only I_1 and I_2 are non-zero or only I_1 is non-zero. It should be noted that the fourth-degree term generates ghosts in all 8 elements and the fifth-degree term in all 16 elements. To obtain higher degree coefficients, the same procedure can be applied by using a Hadamard code of a higher degree (N=32, 64, 128, etc.).

Epilogue

This paper has described basic experiments relating to a Hadamard transform active long-path spectrometer, verified the effectiveness of the method, and discussed the types of Hadamard codes used, statistical errors, and systematic errors. Such a system, representing Hadamard transform optics which modulate the light source directly without using a Hadamard mask, could have several other applications. For example, this author and his colleagues have proposed an atmospheric environmental monitoring system involving long-path spectrometer measurements between the ground and a stationary satellite, using

lasers installed at multiple points on the ground.[8,9] In such an application the Hadamard transform would be used simply to distinguish the light sources. Recently, small LEd arrays for LED printers have been developed, and the use of optical systems using optical fibers has expanded. It is our view that by using these techniques it should be possible to apply Hadamard transform optics in small-scale systems as well.

The author gratefully acknowledges that this work has been supported by the Ministry of Education scientific research promotion grant (A).

FOOTNOTES

1. U. Platt, D. Perner, and H.W. Patz, J. GEOPHYS. RES., Vol 84, 1979 p 6329.

2. D. Perner and U. Platt, GEOPHYS. LETT., Vol 6, 1979, p 917.

3. U. Platt and D. Perner, Ibid., Vol 7, 1980, p 89.

4. U. Platt and D. Perner, in Technical Digest, Workshop on Optical and Laser Remote Sensing, D2, Monterey, California, February 1982.

5. N. Sugimoto, APPL. OPT., Vol 25, 1986, p 863.

6. Nobuo Sugimoto, BUNKO RENKYU [SPECTRAL RESEARCH], Vol 35, 1986, p 225.

7. M. Harwit and N.J. Sloane, "Hadamard Transform Optics," Academic Press, 1979.

8. Nobuo Sugimoto, NIHON REMOTE SENSING GAKKAI SHI [JOURNAL OF JAPANESE REMOTE SENSING SOCIETY], in preparation.

9. N. Sugimoto, APPL. OPT., Vol 26, 1987, p 763.

12743/9365
CSO: 8029/4406

FY87 S&T BUDGETS, STRATEGIES FOR VARIOUS MINISTRIES OUTLINED

STA Overview

Tokyo PUROMETEUSU in Japanese 10 May 87 pp 11-14

[Excerpts] Present Status and Prospects for Japan's Science and Technology Policy

In recent years there has begun to be voiced strongly both within and outside Japan the view that the science and technology which have supported the high growth of Japan's economy emphasize application development, and that creative basic research had been neglected. Nowadays, when we are said to have shifted from high growth to stable growth, a movement has begun to stand out which seeks to greatly change also Japan's science and technology policy from the applied to the basic. That, in turn, has begun to be manifest also in the aspect of budget compilation. It truly appears that science and technology policy is about to enter a period of transition.

FY87: Outline of the Science-and-Technology-Related Budget Proposal: Coordination Division, Science and Technology Policy Bureau, Science and Technology Agency

The promotion of science and technology is a necessary and indispensable foundation in order for Japan, which lacks natural resources, to go on progressing steadily toward the 21st century.

In government we have hoisted aloft the promotion of science and technology as a task of the utmost priority, have created the "Outline of Science and Technology Policy" by cabinet resolution in March 1986, and are planning to promote science and technology rich in creativity, while giving consideration to development in which science and technology are in harmony with people and society, and development of science and technology which places importance on the quality of being international.

In order to strive for promotion of science and technology, the Science and Technology Agency has as its mission the overall promotion of science-and-technology related administration, and, as one of its major duties, carries out overall coordination of science-and-technology-related policies of related

government agencies; the outline and principal content of the FY87 science-and-technology-related budget proposal are given below:

I. The Science-and-Technology-Related Budget

As shown in Table 1 [not reproduced], what is called the S&T Related Budget consists of outlays for promotion of science and technology and research-related outlays within energy-measures expenditures, other research-related expenditures within the General Account, as well as other expenditures appropriated for special accounts.

(Note:)

Science-and-technology-related expenditure in the General Account:

Expenditure for Promotion of Science and Technology

One of the major categories of expenditure in the General Account, it consists of such things as expenditure for national testing and research facilities and various subsidy-type expenditures.

Research-Related Expenditure Within Energy-Measure Expenditure

Research-related expenditure within energy-measure expenditure, which is one of the major categories of the General Account; at the time when energy-measure expenditures were begun in the FY78 budget, it was rearranged from expenditure for promotion of science and technology, and consists of such things as expenditure for promotion of research in peaceful uses of atomic energy and research-and-development expenditure for new-energy technology and energy-conservation technology.

Expenditure for Promotion of Science and Technology Etc.

Research-related expenditure within energy-measure expenditure, added to expenditure for promotion of science and technology.

Other Research-Related Expenditure

Consists of general-account research-related expenditure (included in such things as expenditure to foster the promotion of education, expenditure for economic cooperation, small-and-medium enterprise measures and other items) other than for such things as promotion of science and technology.

Science-and-technology-related expenditure within special accounts

Consists of research-related expenditure within such special accounts as the Special Account for National Schools, Special Account For Electric Power Source Development And Promotion Measures, Special Account for Coal, Petroleum and Petroleum-Substitute Measures and Special Account for Industrial Investment.

II. Total Amount: 1.655 Trillion Yen

The total amount of the FY87 science-and-technology-related budget proposal is 1.655 trillion yen, an increase of 56.1 billion yen, 3.5 percent, when compared with the amount of the initial budget for the previous year, 1.599 trillion yen.

Within this, the science-and-technology-related budget within the general account is 799.5 billion yen, an increase of 15.3 billion yen, 2.0 percent, when compared with the amount of the initial budget for the previous year, 784.2 billion yen.

Furthermore, the science-and-technology-related budget within special-account budgets is 855.5 billion yen, an increase of 40.7 billion yen, 5.0 percent, when compared with the amount of the initial budget for the previous year, 814.8 billion yen.

In compiling the FY87 budget proposal, in the aspect of annual expenditure we have made curtailment and rationalization of expenditure the foundation, and, while controlling the scale strictly, have given consideration to qualitative improvement within limited financial resources; in the midst of the stringent government-finance situation of a minus-comparison with the previous year, general annual expenditure (annual expenditure within the general-account budget excluding expenditure for government bonds, local subsidy tax and local subsidies) gave consideration to the promotion of science and technology. (Table 2)

Table 2. Table Summarizing the FY87 Science-and-Technology-Related Budget Proposal (unit: 1 million yen)

Category \ Fiscal year	FY86 budget amount	FY87 budget amount	Percentage gain/loss from last fiscal year
Expenditure on promotion of science and technology	390,954	400,634	2.5
Research-related expenditure within energy-countermeasure expenditure	173,690	169,267	-2.5
Expenditure on promotion of science and technology etc.	564,644	569,901	0.9
Other research-related expenditure	219,551	229,639	4.6
Science-and-technology-related expenditure in the General Account	784,195	799,540	2.0
Science-and-technology-related			

expenditure in special accounts	814,773	855,500	5.0
Total science-and-technology-related budget	1,598,969	1,655,040	3.5
NOTE: Total amount of General Account	54,088,643	54,101,019	0.0
TE: Annual expenditure in General Account	32,584,170	32,583,369	-0.0

(Note): 1. General annual expenditure is the expenditure when expenditure for government bonds, local subsidy tax and local subsidies has been excluded from the total amount of the General Account.
2. This table was calculated by the Science and Technology Agency.
3. Due to rounding off, the addition of each column does not always agree with the numerical value in the total slot.

III. Breakdown by Agency

When we look at the principal content for major agencies (items below which do not have expanatory notes are in the General Account), to begin with, the total amount for the Science and Technology Agency is 425.2 billion yen (1.2-percent increase), consisting of such items as expenditure for the Power Reactor and Nuclear Fuel Development Corporation (referred to below as Power Fuel Corporation (141.6 billion yen) (included in the Special Account For Electric Power Source Development And Promotion Measures (referred to below as the Power Source Special Account)), expenditure for the Japan Atomic Energy Research Institute (99.5 billion yen), expenditure for special corporations and so on (376.2 billion yen (includes Power Source Special Account, Special Account for Industrial Investment (referred to below as Industrial Investment Special Account)) such as expenditure for the National Space Development Agency (92.6 billion yen), expenditure for such testing and research facilites under its jurisdiction as the National Aerospace Laboratory (26.5 billion yen), the Power Source Special Account for such things as commission expenditure for such things as atomic-power-generation safety measures (10 billion yen (excluding expenditure for the Power fuel Corporation)), and expenditure for coordinating the promotion of science and technology (8.4 billion yen).

The total amount for the Ministry of Education, Culture and Science is 780.2 billion yen (4.6-percent increase), consisting of such items as research-related expenditure for national universities and the like (594.2 billion yen (Special Account For National Schools)), research-related expenditure for

public and private universities and the like (126.2 billion yen), subsidies for science and technology expenditure (45.1 billion yen) and expenditure for such testing and research facilities under its jurisdiction as the International Latitude Observatory (7.0 billion yen).

The total amount for the Ministry of Health and Welfare is 39.8 billion yen (10.1 percent increase); apart from subsidies for scientific testing and research (14.0 billion yen), expenditure for such testing and research facilities under its jurisdiction as the National Institute of Health (9.9 billion yen) and such items of the National Hospital Special Account as subsidies for cancer research (8.6 billion yen), it has newly appropriated 1.0 billion yen (II Special Account) as expenditure for a Fund For Relief of Injury From Side Effects of Pharmaceuticals And Promotion of Research (provisional name).

The total amount for the Ministry of Agriculture, Forestry and Fisheries is 66.7 billion yen (0.4-percent increase), consisting of such items as expenditure for such testing and research facilities under its jusrisdiction as the National Agricultural Experiment Station (44.9 billion yen), expenditure for such strengthening of research on agricultural, forestry and fisheries technology as research on development of high-technology leading-edge technology (9.4 billion yen), expenditure for the structure for promoting research on technologies for specific biosystem industries (800 million yen) (General Account), 3.8 billion yen (II Special Account)).

The total amount for the Ministry of International Trade and Industry is 221.4 billion yen (1.8-percent increase), consisting of such items as expenditure for such testing and recearch facilites under its jurisdiction as the Electrotechnical Laboratory (31.1 billion yen), research and development on new energy technology (29.7 billion yen (including Power Source Special Account and Special Account for Coal and Petroleum-Substitute Energy Measures (referred to below as Petroleum Special Account))), Measures for technology for developing atomic-power generation (27.0 billion yen (Electric Source Special Account)), expenditure for Japan Key Technology Center (25.0 billion yen (Industrial Investment Special Account)), R & D for large-scale industrial technology (13.9 billion yen (includes Electric Source Special Account, Petroleum Special Account)), R & D for energy-conservation technology (11.4 billion yen (includes Electric Source Special Account, Petroleum Special Account)) and R & D For Next-Generation Industries (6.0 billion yen (includes Petroleum Special Account)).

The total amount for the Ministry of Transport is 14.5 billion yen (9.4-percent increase), consisting of such items as expenditure for such testing and research facilities under its jurisdiction as the Ship Research Institute (7.3 billion yen) and expenditure connected with stationary weather satellites (5.4 billion yen).

The total amount for the Ministry of Posts and Telecommunications is 29.0 billion yen (17.7-percent increase), consisting of expenditure for the Japan Key Technology Center (25.0 billion yen (Industrial Investment Special Account)) and expenditure for the Radio Research Laboratory (4.0 billion yen).

The total amount for the Ministry of Construction is 5.5 billion yen (5.3-percent decrease), consisting of such items as expenditure for such testing and research facilities under its jurisdiction as the Public Works Research Institute (4.4 billion yen) and expenditure for construction-technology R & D (600 million yen).

A breakdown of the FY87 science-and-technology-related budget proposal by agencies is shown in Table 3.

Table 3. Table Summing Up the FY87 Science-And-Technology-Related Budget Proposal By Agency (unit: 1 million yen)

表--3 昭和62年度科学技術関係予算案省庁別総括表 (単位：百万円)

1 事項 / 2 省庁名	25 科学技術振興費 A	対前年度増減率%	26 エネルギー対策費中の研究関係費 B	対前年度増減率%	28 科学技術振興費等 C=A−B	対前年度増減率%	29 その他の研究関係費 D	対前年度増減率%	30 一般会計中の科学技術関係費 E=C+D	対前年度増減率%	31 特別会計中の科学技術関係費 F	対前年度増減率%	32 科学技術関係予算案総額 E+F	対前年度増減率%
3 国会	525	1.5	—	—	525	1.5	—	—	525	1.5	—	—	525	1.5
4 日本学術会議	—	—	—	—	—	—	856	△ 0.8	856	△ 0.8	—	—	856	△ 0.8
5 警察庁	925	2.9	—	—	925	2.9	—	—	925	2.9	—	—	925	2.9
6 北海道開発庁	143	0.6	—	—	143	0.6	—	—	143	0.6	—	—	143	0.6
7 防衛庁	—	—	—	—	—	—	74,135	12.1	74,135	12.1	—	—	74,135	12.1
8 経済企画庁	710	0.8	—	—	710	0.8	—	—	710	0.8	—	—	710	0.8
9 科学技術庁	160,765	4.2	163,966	△ 2.2	324,731	0.9	8,942	5.2	333,674	1.0	91,559	1.9	425,232	1.2
10 環境庁	7,914	△ 4.9	—	—	7,914	△ 4.9	—	—	7,914	△ 4.9	—	—	7,914	△ 4.9
11 国土庁	160	△ 23.7	—	—	160	△ 23.7	—	—	160	△ 23.7	—	—	160	△ 23.7
12 法務省	806	△ 0.3	—	—	806	△ 0.3	—	—	806	△ 0.3	—	—	806	△ 0.3
13 外務省	—	—	2,531	△ 1.8	2,531	△ 1.8	3,767	△ 6.2	6,298	△ 4.5	—	—	6,298	△ 4.5
14 大蔵省	335	1.9	—	—	335	1.9	—	—	335	1.9	674	10.5	1,009	7.5
15 文部省	59,759	3.5	—	—	59,759	3.5	126,172	1.1	185,931	1.9	594,243	5.5	780,174	4.6
16 厚生省	29,886	6.7	—	—	29,886	6.7	1,225	△ 2.0	31,111	6.3	8,649	26.2	39,761	10.1
17 農林水産省	61,098	0.6	—	—	61,098	0.6	1,851	△ 4.8	62,948	0.4	3,800	0	66,748	0.4
18 通商産業省	54,527	△ 3.4	2,770	△ 18.6	57,297	△ 4.2	11,574	8.4	68,871	△ 2.3	152,538	3.7	221,409	1.8
19 運輸省	12,758	10.8	—	—	12,758	10.8	754	32.0	13,512	11.8	1,004	△ 15.5	14,516	9.4
20 郵政省	4,037	△ 2.1	—	—	4,037	△ 2.1	5	△ 88.0	4,042	△ 3.0	25,000	22.0	29,042	17.7
21 労働省	601	0.4	—	—	601	0.4	0.7	0	602	0.4	3,033	27.9	3,635	22.4
22 建設省	5,149	1.7	—	—	5,149	1.7	356	△ 52.6	5,506	△ 5.3	—	—	5,506	△ 5.3
23 自治省	536	1.6	—	—	536	1.6	—	—	536	1.6	—	—	536	1.6
24 合計	400,634	2.5	169,267	△ 2.5	569,901	0.9	229,639	4.6	799,540	2.0	855,500	5.0	1,655,040	3.5

Key:

1. Item
2. Agency name
3. Diet
4. Science Council of Japan
5. National Police Agency
6. Hokkaido Development Agency

7. Defense Agency
8. Economic Planning Agency
9. Science and Technology Agency
10. Environment Agency
11. National Land Agency
12. Ministry of Justice
13. Ministry of Foreign Affairs
14. Ministry of Finance
15. Ministry of Education, Culture and Science
16. Ministry of Health and Welfare
17. Ministry of Agriculture, Forestry and Fisheries
18. Ministry of International Trade and Industry
19. Ministry of Transport
20. Ministry of Posts and Telecommunications
21. Ministry of Labor
22. Ministry of Construction
23. Ministry of Home Affairs
24. Total
25. Expenditure for promotion of science and technology
26. Percentage of increase or decrease from previous fiscal year
27. Research-related expenditure within energy-countermeasure expenditure
28. Expenditure for promotion of science and technology etc.
29. Other research-related expenditure
30. Science-and-technology-related expenditure within the General Account
31. Science-and-technology-related expenditure within special accounts
32. Total amount of science-and-technology-related budget proposal

(Note): 1. In regard to the science-and-technology-related budget within the Industrial Investment Special Account which is under the jurisdiction of the Ministry of Finance, the 4.3-billion-yen expenditure for the Japan Information Center of Science and Technology [JICST] is appropriated to the Science and Technology Agency, the 1.0-billion-yen expenditure for the Fund For Relief of Injury From Side Effects of Pharmaceuticals And Promotion of Research (provisional name) is appropriated to the Ministry of Health and Welfare, and the 3.8-billion-yen expenditure of the Framework for Promoting Research on Technologies For Specific Biosystem Industries is appropriated to the Ministry of Agriculture, Forestry and Fisheries, in addition to which the 25.0-billion-yen expenditure for the Japan Key Technology Center is appropriated so that it overlaps MITI and the Ministry of Posts and Telecommunications respectively. (Furthermore, it has been arranged so that totals will not come out to be overlapping totals.)
2. This table was collected and compiled by the Science and Technology Agency.
3. Due to rounding off, the addition of a column sometimes disagrees with the figure in the totals row.

Education, Science and Culture

Tokyo PUROMETEUSU in Japanese 10 May 87 pp 15-17

[Text] FY87: Ministry of Education, Science and Culture's Main Measures Related to the Promotion of Science

Science Division, Science and International Affairs Bureau, Ministry of Education, Science and Culture

Along with carrying out such broad research as the pursuit and systematization of new knowledge and technology and the development of leading-edge research areas covering the cultural sciences, the social sciences and the natural sciences, it is the mission of scientific research which is centered on universities, as something indivisible from this, to strive to train persons of ability in all areas, beginning with superior researchers. By nature, this kind of scientific research is something for which excellent results cannot be hoped for unless it is developed with the free and broadminded conception and desire for research of the researcher as the source; moreover, it is shouldering an extremely important role as the foundation for development of Japan's society, economy and culture. In particular, expectations and demands toward universities, which are the main facilites for conducting basic research, are increasing also for the solution of such vital tasks which Japan is confronting today as research and development of leading-edge science and technology.

In promoting science the main measures have been advanced while respecting the opinion of such as the Science Council, which is composed of excellent researchers from every field; the following is an outline of the Ministry of Education, Science and Culture's main measures related to promotion of science in FY87.

Expansion of Expenditure for Scientific Research

Scientific-research subsidies are major research grants-in-aid for researchers at universities and so on for the purpose of markedly developing excellent scientific research; we strive to promote the research by establishing various items in accordance with such things as its content and character. In FY87, along with raising the total amount by 1.6 billion yen to make it 45.1 billion yen, we have newly planned such expansions as newly establishing "Priority Area Research" (50 million yen to 600 million yen for a single area in a single fiscal year) as an item which for a specific period (3 to 6 years) promotes on a priority basis and in a maneuverable manner research in areas for which there is strong scientific and social demand.

Improving the Scientific-Research Setup

In order to promote scientific research it is necessary to plan to improve and amplify universities, which are the main facilities for such research, and laboratories and so on which are related to universities, while basing one's activities on scientific and social demands. In FY87, we will strive to improve and expand in such various cases as abolition of the Chiba University Bioactivity Laboratory, reorganization of the Tohoku University Metal Materials Laboratory and the Kyushu University Production Science Laboratory and new establishment of the Tokyo University Leading-Edge Science and Technology Center and the Osaka University Biomedical Education and Research Center in addition to newly establishing the International Center for Research on Japanese Culture as the 12th facility for joint use by national universities.

Fostering of Excellent Researchers

In order to foster excellent young researchers, in addition to striving to improve the equipping of graduate schools, in regard to the "special research staff," a full-scale fellowship system established in FY85, we will carry out an increase in the number of newly-hired staff (324 newly-hired staff, 2-year period) and increase the amount of the research-fellowship money, and strive for its expansion.

Promotion of Important Basic Research

(Energy-related science) At the High-Energy Physics Laboratory, a world-ranking leading-edge research facility, in addition to beginning full-fledged experiments and research using TRISTAN we will set to work building up the radiation-experiment equipment. Moreover, in regard to nuclear-fusion research, we will continue to promote research by all kinds of methods such as TOKAMAK, HELIOTRON and laser.

(Elucidation of space and the earth environment) In addition to manufacturing such things as satellites for the purpose of observing such things as the phenomenon of the emission of light for the aurora, the Space Science Laboratory is taking the lead in developing a space experment and observation Free Flyer, which is a reusable, unmanned space laboratory. Furthermore, as the 4th year of the Fifth Earthquake Prediction Plan and the Third Volacanic-Eruption Prediction Plan, we will promote basic research for the purpose of elucidating the mechanism for their occurrence. Moreover, for the purpose of promoting surveying and research in the ocean, we will begin construction on the newest and best research vessel (approximately 4,000 tons) as a replacement for the Tokyo University Marine Laboratory's "Hakuho Maru" [White Phoenix].

(South Polar Region Survey Project) In regard to the South Polar Region Survey Project which is being carried out centered on the National Polar Laboratory, along with advancing the equipping of the "Asuka Observation Base," which is the third base, beside regular observation, it is executing research on the snow and ice and geology of the East Queen Maud Land region as a priority.

(Promotion of the "10-Year Comprehensive Strategy Against Cancer") Adding to the measures which we have been advancing up to now, we will conduct such things as intensive promotion of priority-task research and a survey of overseas cancer research.

Strengthening of Social Cooperation and Teamwork

In addition to planning further improvement of such things as the "system for joint research with the private-sector and so on, the "commissioned-research-staff system" and the "scholarship-donation system" in order to promote joint research and so on with the private-sector and so on, we have newly planned such improvements as new establishment of "joint-research centers" in three

universities as locations for joint research by industry, academia and government.

Promotion of International Interchange and Cooperation in Scientific Research

We are planning further expansion covering the aspects of bilateral and multilateral international joint research, exchange of researchers, holding of international research gatherings and interchange of scientific information, with promotion of international joint-research projects including three new items such as the WCRP (World Climate Research Project), promotion of overseas scientific research through expenditure for scientific research (over 1.8 billion yen) and expansion of interchange with developing countries through the base-university formula (15 interchanges).

Main Items of the FY87 Budget Proposal Related to the Ministry of Education's Science and International Affairs Bureau

Item	Amount decided for FY87 rough estimate	Budget amount for preceding fiscal year
(unit:	1,000 yen	1,000 yen)
1. Expansion of subsidies for expenditure on scientific research		
Subsidies for expenditure on scientific research	45,080,000	43,500,000

Note:

1. Promotion of priority-area research	(10,920,000) 11,670,000
2. Promotion of creative, leading edge, basic research	(5,520,000) 5,720,000
3. Encouragement of superior research by young researchers	(4,230,000) 4,410,000
4. Promotion of joint research with private-sector researchers etc.	(3,615,000) 3,715,000
5. Promotion of overseas scientific research	(1,525,000) 1,825,000
	(980,000)

6. Promotion of dissemination and publication of research results	1,030,000		
	(16,710,000)		
7. Promotion of superior research plans etc.	16,710,000		
2. Improvement of scientific-research setups			
(1) Improvement of research setups		7,989,838	6,816,096
Note:			
	(63,524)		
1. Establishment of International Center for Research on Japanese Culture (provisional name)	308,017		
2. Abolition, conversion etc. of Chiba University Bioactivity Laboratory	(6,752,572)		
3. Promotion of joint research etc. with private sector etc.	7,681,821		
	(1,843,000)		
(1) Joint research	2,095,200		
	(4,909,572)		
(2) Commission research	5,451,368		
	(0)		
(3) Establishment of joint research center	135,253		
(3) Fostering of young researchers		1,148,496	768,240
Note:			
Improvement of fellowship system (Japan Society for the Promotion of Science) Special research staff: Newly hired: 244 to 324 (increase of 80) {Total hired: 388 to 568 (increase of 180)}			
3. Promotion of important basic research			
(1) Promotion of energy-related science		26,294,678	27,933,383
	(14,906,907)		
1. Energy research	13,391,838		
	(8,227,951)		
(1) Nuclear-fusion research	7,654,222		

	(6,678,956)		
(2) New energy, energy-conservation research etc.	5,737,616		
	(13,026,476)		
2. Accelerator science Execution of experimental research through new large accelerator (TRISTAN) (High-Energy Physics Laboratory)	12,902,840		
(2) Elucidation of space and earth environments		19,750,901	17,998,120
	(12,375,022)		
1. Space science Implementation of scientific observation etc. by means of science satellites and observation rockets (Space Science Laboratory)	11,824,785		
	(522,500)		
2. Marine science	2,982,500		
	(0)		
(1) Construction of replacement for research vessel "Hakuho Maru"	2,575,000		
	(522,500)		
(2) Share of expenses for international deep-sea excavation plan	407,500		
	(2,042,221)		
3. Prediction of earthquakes, volcanic erruptions	2,053,326		
	(3,058,377)		
4. South-polar-region observation project Implementation of 29th observation	2,890,290		
(3) Promotion of "10-year comprehensive strategy against cancer"		1,844,512	1,760,126
Note: Promotion of cancer research through genetic engineering etc.			
4. Promotion of international interchange International scientific interchange		3,593,856	3,465,204
	(589,242)		

1. Interchange with developing nations 643,285
(Japan Society for the Promotion of Science)

(1) Interchange through base-university formula
(13 exchanges to 15 exchanges)
Sophia University (science)-Philippines (Ateneo de Manilla University)
Tokyo University of Agriculture (agriculture)-Thailand (Khon Kaen University)

(2) Dissertation assistance to doctoral candidates
Accepted: 36 to 42 (increase of 6 persons)
Dispatched: 18 to 21 (increase of 3 persons)

2. International joint research etc.	(2,594,293) 2,566,096
(1) International joint research projects	(2,472,539) 2,435,868
(2) Holding of international symposia etc.	(121,754) 130,228
3. Cooperation with UN University Design and execution of headquarters facilities etc.	(281,669) 384,475

MITI

Tokyo PROMETEUS in Japanese 10 May 87 pp 18, 19

[Text] Ministry of International Trade and Industry: Concerning Industrial-Science-and-Technology-Related Policy

General Coordination Division, Agency of Industrial Science and Technology, Ministry of International Trade and Industry

At MITI we have made the FY87 technology-development-related budget 196.4 billion yen (see attached table), and will go on developing a comprehensive industrial-technology policy actively while placing emphasis on the following types of measures.

First of all, is active promotion of international cooperation in research. In order to to go on contributing to the activation of international economy and society via creative development of technology by making use of Japan's technological strength and economic power, we shall promote actively such research interchange with various foreign countries as promotion of international joint research projects, such research cooperation with advanced

nations as specific international joint research projects centered on leading-edge-technology fields and such research cooperation with developing nations as international industrial technology projects for the purpose of attempting to promote the transfer of technology.

Furthermore, particularly as the basic direction for science and technology into the 21st century, we shall advocate to the world a Human Frontier Science Program which promotes under international cooperation "creative basic research centered on elucidation of the superior functions possessed by organisms," which is anticipated to be a storehouse of such technology needs as future engineering applications, and will strive to promote it in an active manner while cooperating with related agencies of the government.

To begin with, in regard to the R & D System For Next Generation Industries and large projects, we will strive for such steady promotion as attempting full-fledged development of the "bioelement" and "ultra leading-edge processing systems" on which work was begun in FY86.

Concerning development of energy-related technology, we will attempt active promotion centered on the Sunshine Plan and the Moonlight Plan. Moreover, in space-development-and-aircraft-related fields, along with actively promoting such things as development of an unmanned space experimentation system (space experiment and observation free flyer), we will also grapple actively with development of technology in information-related, new-materials-related fields and so on.

Furthermore, in the field of leading, basic R & D, which, as the common property of mankind, forms the foundation for development of future industrial society, it is thought that the role played by national testing and research laboratories will become more and more important in the future, so, particularly by such things as the ensuring of persons of talent and of improvement of facilities, along with striving to expand their functions and enhance their vitality, we will try to enhance the technological level of the entire nation and contribute to international society through actively promoting activity to use and disseminate the results of research.

Thirdly, in order to advance technological development in a smooth and efficient fashion, it is extremely important to go on using the potential of the private sector, so we will strive to improve environmental conditions for that purpose. Therefore, in the Japan Key Technology Center, which has been established in order to attempt to promote experimental research concerning basic technology which is carried out in the private sector, in addition to sttempting to expand the content of its duties such as making loans, it will attempt to promote still further all types of measures which promote development of technology in the private sector, such as tax-system measures and all kinds of promotion systems such as subsidies for R & D of technology for industrial activation and so on. In addition, the Research-Interchange Promotion Law was established some time ago as a systematic base for promoting interchange of research between government and the private sector, and along with attempting the active use of this system, we will actively promote interchange of research by attempting to prepare the infrastructure for interchange of research which makes use of expansion and strengthening of the

Government-Private-Sector Solidarity Joint Research System and the Private-Sector Use Law.

Outline of MITI's FY87 Technology-Development-Related Budget Proposal

(unit: 100 million yen)

Item	FY86 budget	FY87 budget	increase/ decrease
Total amount requested for technology-development-related budget	1,971	1,964	-6
Of which: General Account	705	689	-16
Special accounts	1,265	1,275	10
Note: Does not include Industrial Investment Special Account			
Major items			
Next-generation-industry basic-technology R&D	64	60	-3
(The three fields of new materials, biotechnology and new function elements)	(9)	(12)	(3)
Note: Shift to full-fledged R&D of bioelements			
Large projects	152 (87)	151 (94)	-1 (7)
Remarks: Shift to full-fledged R&D of ultra-leading-edge processing systems			
Sunshine Plan	430 (406)	441 (420)	11 (15)
Moonlight Plan	123 (112)	114 (106)	-9 (-6)
R&D of medical treatment/welfare device technology	7	7	-0
Note: Will start fresh on equipment to classify white-blood corpuscle-types automatically and a mechanical mat for use in preventing bedsores			
Fifth-generation computer R&D	55	56	1

	(10)	(16)	(6)
Development of technology for new materials and equipment systems to be used in collective housing [shugojutaku] (21st century apartment)	9 (7)	10 (7)	1 (1)
International joint development of aircraft (YXX, V2500)	47	47	-0
Development of unmanned space-experiment system (space experiment and observation free flyer)	2 (0)	17 (13)	15 (13)
R&D of observation systems for use in resource investigation	45 (43)	51 (50)	6 (6)
Note: Begin development of actual launch vehicle (includes 3.1 billion yen appropriated for large projects)			
Tests to confirm technology of new reactors for use in generating electricity	0 (0)	40 (40)	40 (40)
Note: Such things as promotion of practical development of fast breeder reactors etc. (new)			
Development of technology for an atomic-laser-method uranium-enrichment system	0 (0)	43 (43)	43 (43)
Note: Such things as development of equipment required in the manufacture of experimental machinery such as laser devices (new)			
Government-private-sector-solidarity joint research	2	3	1
Area system-technology development projects	5	7	3
Promotion of research cooperation vis-a-vis developing nations	8	10	2
Note:			

Begin research cooperation concerning machine-translation systems between neighboring countries			
Specific international joint research	0.4	0.5	0.1
Projects related to the Human Frontier Science Program	0	0.5	0.5
Note: Separately, 150 million yen is scheduled within expenditure for promotion and coordination of science and technology (ultimately will be decided at the practical-development stage)			
Provision of industrial-investment financing to the Japan Key Technology Center	205	250	45
Note: Industrial Investment Account			

(Note 1) Figures within parentheses are from special accounts, and an unspecified portion of the amounts on the row above will be applied to the area in question.
(Note 2) Due to rounding off, fractions do not always agree.

Agriculture, Forestry and Fisheries

Tokyo PROMETEUS in Japanese 10 May 87 pp 20-22

[Text] Ministry of Agriculture, Forestry and Fisheries Priority Measures Seen in the FY87 Budget Proposal

Liaison and Coordination Division, Secretariate, Agriculture, Forestry and Fisheries Research Council, Ministry of Agriculture, Forestry and Fisheries

On 28 November 1986 a report entitled "The Basic Direction of Agricultural Administration Approaching the 21st Century: Aiming for Enhancement of Agricultural Productivity and Formation of Rational Prices for Agricutural Products" was submitted to the minister for agriculture, forestry and fisheries by the Agricultural Administration Council. It is something important which should become a guideline for agricultural administration in the future, and in this report it is held that, in the promotion of research and development, "approaching the 21st century, a more active response is needed which aims for establishment of appealing agriculture and promotion of the food industry and includes expansion toward new research areas"

The FY87 agriculture, forestry and fisheries budget is 3.286 trillion yen, 96.4 percent of the previous fiscal year's budget, but within this the budget for agriculture,-forestry-and-fisheries-related testing and research shows a

slight increase at 61.8 billion yen, 100.5 percent compared with that of the previous fiscal year; so, in the midst of a stringent government-finance situation, consideration has been given to the importance of technological development. Principal items in the FY87 budget are introduced below.

I. Promotion of Biotechnology-Development in the Agriculture, Forestry and Fisheries Industries, the Food Industry and so on

In order to promote such things as development of epoch-making new varieties which are superior in resistance to disease, yield and so on and production of new crops which fit consumer needs, based on a long-term point of view which sees into the 21st century, we will do such things as develop technology in order to promote in a planned and integrated manner plant breeding which makes use of biotechnology, as well as preparing the agriculture, forestry and fisheries gene bank which forms the foundation of this. As one link in this, we shall set to work on "research concerning the explication of the base sequence of plant DNA" and "evaluation of the safety of recombinant bodies in an outdoor environment," which develop various techniques for newly elucidating efficiently the basic arrangement of plant genes, and "research concerning development of a bionursery system," which does such things as develop technology for generating seedlings from and acclimatizing cultivated plants which are given new characteristics through biotechnology.

Promotion of Technological-Innovation Projects Concerning The Food Industry Etc.

In order to promote technological innovation of such agriculture, forestry and fisheries-related industries as food, agricultural chemicals and fertilizers, we shall attempt active development of biotechnology under cooperation of industry, academia and government, while making the most of the vitality of the private sector, and shall set to work newly on research which will improve enzymes in order to make possible such things as enhancing productivity and rationalizing the sterilization process in the manufacture of foodstuffs.

II. Promotion of Large-Project Research Etc.

(1) Promotion of Large-Project Research

Regarding innovative technologies which are based on a long-term point of view, we will continue to advance the Biomass Conversion Plan for using reproducible, not yet utilized resources in a diversified manner, the Marine Ranching Plan for attempting to increase coastal fisheries resources and the Clean Energy Plan for using natural energy efficiently.

(2) Promotion of Integrated, Systematic Research For Such Things as Enhancing Productivity

As one link in the measures to firmly establish paddy-field agriculture, we will set to work on such integrated technological development as development of technology for enhancing productivity through wet-land rice and substitute crops [tensaku sakumotsu], establishment of a system of a technical system for area crop rotation in order to advance paddy-field utilization and

nurturing of epoch-making new varieties of high-quality, high-yield dry-field crops.

Outline of FY87 Agriculture, Forestry and Fisheries-Related Budget Proposal For Testing And Research

Item	FY86 budget	FY87 budget
I. Promotion of development of biotechnology in agriculture, forestry, fisheries and the food industry	2,579	2,805
1. Promotion of "high-tech plant breeding for the year 2000"	2,032	2,146
(1) Research on elucidation of basic arrangement of plant DNA	0	69
(2) Promotion of integrated research on biotech plant breeding	445	449
(3) Promotion of regional biotechnology R&D	234	256
(4) Development of basic technology etc.	420	376
1) Research on development of a bionursery system	0	33
2) Development of methods for evaluating the safety of rearranged organisms in an outdoor environment	0	22
3) Research on high-technology-leading-edge-technology seed cultivation	100	100
4) Elucidation of the gene-expression mechanism in agricultural organisms	44	71
(5) Expansion and strengthening of collection and management of genetic resources and data --Preparation of an agriculture, forestry and fisheries gene bank etc.--	915	978
1) Preparation of an integrated management/ utilization system for agriculture, forestry and fisheries genetic resources and genetic breeding information	436	461
2) Preparation of facilites for managing agriculture, forestry and fisheries genetic resources	363	429

2. Promotion of technology-innovation projects concerning food industry etc.	548	659
1) Development of enzyme-function-conversion technology in the food industry	0	110
2) Development of bioreactor systems in the food industry	259	244
3) Elucidation of movement in the rhizosphere environment and development of control-technology	95	95
I. Promotion of large-project research etc.	3,431	3,265
1. Promotion of large-project research	1,366	1,275
1) Integrated research on development of technology for efficient utilization of bioresources (Biomass Conversion Plan)	441	444
2) Integrated research on development of a system for converting the coastal fisheries resources to domestic fish (Marine Ranching Plan)	423	410
3) Integrated research on technology for efficient use of natural energy in the agriculture, forestry and fisheries industries (Clean Energy Plan)	502	421
2. Promotion of integrated, systematic research in order to enhance productivity etc.	1,476	1,409
1) Development of high-quality, high-yield dry-field crops and establishment of high-order stable-production technology for advancement of paddy-field utilization	312	328
2) Development of ultra-high-yield crops and establishment of cultivation technology	302	263
3) Development of information processing systems for building of agricultural production-management systems	131	151
4) Integrated research on the national-land resources possessed by the agriculture, forestry and fisheries industries, the conservation function of the environment and its preservation and improvement	150	94

III. Promotion of international cooperation in research Within promotion of research on tropical agriculture: basic-technology research (new)	496	536
IV. Encouragement of urban and non-urban prefecture testing and research etc.	2,819	2,658
V. Such things as operation and improvement of testing and research facilities	53,329	52,870
VI. Strengthening of a system for promoting private-sector development of new technology	(3,800) (finance provided by Industrial Investment Special Budget)	(3,800)

--Strengthening of Structure for Promotion of Technology-Research in Specific Biosystem Industries--

Provision of finance concerning work of promoting private-sector R&D which is carried out by the Structure for Promotion of Technology-Research in Specific Biosystem Industries

(Content of Work)

1) Finance work
Loan ceiling: 2,000 (1,300)

{Will provide necessary finance for enterprises}
{etc. which carry out technology-research }
{concerning agriculture, forestry and }
{fisheries industries etc. (conditional }
{interest-free loans). }

2) Investment work
Investment ceiling: 800 (500)

{In a case where two or more enterprises jointly}
{carry out technology-research concerning }
{agriculture, forestry and fisheries industries }
{etc., will invest in said joint technology- }
{development corporation. }

3) Mediation concerning joint research by an enterprise etc. and government testing and research facilities

4) Mediation concerning provision to enterprises etc. of plant etc. gene resources by the "agriculture, forestry and fisheries gene bank"

5) Other: invitation of researchers from overseas, commission research, provision of information, surveys etc.

(Note): FY86 is initial budget amount

---

3. Promotion of International Research-Cooperation

In order to contribute to rapid enhancement of agricultural and forestry productivity in tropical regions and so on, we will, jointly with the nation concerned, inaugurate basic-technology research to develop seed-technology to form the foundation for development of innovative technology systems by elucidating such things as the development mechanism of plants in the characteristic environments of these regions.

4. Encouragement of Urban and Non-Urban Prefecture Testing and Research Etc.

We will encourage such things as improvement of regional bioresources and development of technology for their utilization through biotechnology methods carried out jointly by testing and research facilities of urban and non-urban prefectures.

5. Operation and Improvement of Testing and Research Facilities

In order to ensure the smooth promotion of testing and research, in addition to continuing to promote the improvement of research facilities and machinery, we shall initiate work on urgent improvement of the Tsukuba research facilities and so on in order to avoid deterioration of facilities and equipment due to obsolescence, interruption of testing and research due to corrosion and other irrecoverable situations.

6. Strengthening of a Support System for Private-Sector R&D

In order to promote broadly R&D concerning biotechnology and other biosystem industrial technologies, in addition to providing financing to the private sector, we will continue to provide financing from the Industrial Investment Special Account to the Structure For Promotion of Technology-Research in Specific Biosystem Industries which carries out such work as mediation in joint research with the government.

Health and Welfare

Tokyo PUROMETEUS in Japanese 10-May 87 pp 22-24

[Text] New Ministry of Health and Welfare Measures Seen in the FY87 Budget Proposal

Office of Life Science, General Affairs Division, Minister's Secretariat, Ministry of Health and Welfare

In the past few years, accompanying rapid aging of the population structure, changes in the illness-structure, diversification of people's needs and conspicuous progress of science and industry, from application of new materials to rearrangement of DNA, along with aging and internationalization many new problems have also arisen in the welfare science field. Thus, in order for welfare administration too to deal with this, it is necessary to respond to society's demands by grappling with promotion of research concerning also such things as biotechnology, medical-use-materials system science and research, medical treatment information and electronic-engineering system science and technology.

In particular, technology connected with such things as biotechnology, new materials and information and electronic engineering, which have been attracting interest recently, have all kinds of broad fields of application, from the basic field of elucidation of the phenomenon of life, to application to the prevention, diagnosis and treatment of cancer, cardiovascular diseases, incurable diseases and so on, or development and production of artificial organs and completely new pharmaceuticals, insurance and medical treatment information systems to application to water supply and waste disposal, so the results in this field circulate to the people of the nation and are useful in a rich national life.

In the Ministry of Health and Welfare we have for a long time strongly promoted research in its respective fields and levels, such as basic research in national testing and research facilities and clinical research in national hospitals.

However, a considerable part of R&D in Japan is conducted in private-sector enterprises, and causing the results of science and technology to bear fruit as concrete pharmaceuticals or medical treatment instruments, and providing them to the venue of medical treatment is the mission of private enterprise. While giving consideration to this kind of actual situation and role, along with inducing R&D in the private sector to be something which aims at the conquest of national problems, it has begun to become extremely important to attempt its further promotion.

Development of pharmaceuticals, medical instruments and so on for which a high degree of safety and effectiveness are demanded requires huge investment and a long period of development, and the development risk is also very great, so it is impossible to hope for active grappling with these tasks by the independent efforts of private-sector enterprises alone.

In light also of this kind of R&D trend, we have conceived of a finance system which by means of an official system will actively assist grappling with development of leading-edge technology for biotechnology and so on in private-sector enterprises, and should promote R&D of epoch making new medicines and so on.

Outline of the Ministry of Health and Welfare's FY87 Science and Technology

Related Budget Proposal (unit: 1 million yen)

Item	FY86 budget	FY87 budget
Ministry of Health and Welfare	35,969	39,761
(Expenditure for promotion of science & technology)	28,015	29,886
Institute of Population Problems	276	288
Institute of Public Health	1,387	1,432
National Institute of Mental Health	179	0
National Institute of Nutrition	432	453
National Institute of Health	4,361	4,464
(of which, expenditure for 10-year integrated anti-cancer strategy is)	(57)	(57)
Tama National Institute	305	303
National Institute of Hospital Administration	154	157
National Institute of Hygienic Sciences	2,765	2,770
(of which, expenditure for 10-year integrated anti-cancer strategy is)	(90)	(90)
(Testing and research facility subtotal)	9,858	9,867
Expenditure for commissioning Japanese-U.S. medical cooperative research projects	90	105
Subsidies for expenditure on science testing and research	12,860	13,972
Tuberculosis Institute subsidy	418	445
Radiation-Effect Institute subsidy	1,946	1,980
Subsidy for expenditure in welfare-science research	2,842	3,518
(of which, expenditure for the 10-year integrated anti-cancer strategy is)	(1,388)	(1,638)
(Subtotal for subsidies etc.)	18,157	20,019
(Other research-related expenditure) (General Account)	1,251	1,225
Contribution for international cancer-research facilities Note: and expenditure for other items	132	105
Expenditure for commissioning surveys and research on illnesses caused by atomic bomb radiation Note: health-insurance countermeasures expenditure	140	140
Expenditure for commissioning survey on victims of poison gas Note: and expenditure for other items	271	295
Expenditure for commissioning survey on development of database system regarding water quality Note: and expenditure for other items	2.2	2.0

Expenditure for commissioning development of an industrial-waste-disposal technology system Note: and expenditure for other items	22	17
Expenditure for such things as development and dissemination of medical treatment data systems Note: and expenditure for other items	263	221
(Expenditure for development and dissemination of medical treatment data systems)	(228)	(210)
(Expenditure for commissioning tuberculosis, contagious-disease monitoring system)	(36)	(11)
Expenditure for commissioning testing and surveying of pharmaceuticals etc. Note: and expenditure for other items	180	239
Subsidy for expenditure in development of new systems of waste disposal Note: and expenditure for other items	240	206
(Science and technology-related expenditure in the General Account)	29,265	31,111
(Science and technology-related expenditure in special accounts) Note: National Hospital Special Account	6,704	8,649
Expenditure for National Cardiovascular Disease Center laboratory Note: (hospital bill)	1,540	1,626
Expenditure for National Cancer Center laboratory Note: (hospital bill)	1,344	1,364
Expenditure for National Mental and Nerve Center laboratory Note: (sanitorium bill)	762	1,480
Cancer-research subsidy Note: (hospital bill)	1,600	1,600
Expenditure for commissioning cardiovascular disease research Note: (hospital bill)	450	550
Expenditure for commissioning nervous-disorder research Note: (sanitorium bill)	450	550
Expenditure for National Hospital		

treatment-research Note: (hospital bill)	358	368
Expenditure for National Tuberculosis Sanitorium treatment-research Note: (sanitorium bill)	174	86
Expenditure for treatment-research by facilities for children (adults) with serious psychosomatic disorders Note: (sanitorium bill)	21	21
Expenditure for treatment-research by facilities for children (adults) with progressive muscular dystrophy Note: (sanitorium bill)	4.2	4.2
Expenditure for the Foundation for Promotion of Research and Relief of Injury Caused by Side-Effects of Pharmaceuticals (provisional name) Note: Industrial Investment Special Account	0	1,000

In order to establish this system, we will implement it by reorganizing the existing corporations under the jurisdiction of the Ministry of Health and Welfare and adding new duties. Thus, fully understanding the special characteristics of pharmaceuticals through the past work of relieving the injury caused by their side-effects and taking into consideration the point that this funding system is expected to contribute to the enhancement of pharmaceutical safety, we shall reorganize the "Foundation for Relief of Pharmaceutical Side-Effect Injury," change the name of the corporation to "Foundation for Promotion of Research and Relief of Injury Caused by Side-Effects of Pharmaceuticals" and carry out this work of promoting research.

As to expenditure required in the management and operation of the work of promoting research, with money invested from the Industrial Investment Special Account (700 million yen for FY87) and money invested from the private sector as its endowment, the expenditure is financed by profit from its investment, and business expenses for making loans are supplied by investment from the Industrial Investment Special Account and by loans (100 million yen and 200 million yen respectively for FY87).

The industrial areas to which loans are made is that centered on pharmaceuticals and medical instruments and apparatus. As to the financing, in the case where two or more enterprises establish a joint R&D corporation, the foundation expects to invest up to a maximum of 70 percent of the funds needed for their activities. As to the loans, in the case where a private-sector enterprise conducts R&D, the foundation will hold off during the period of R&D (5 years is the preliminary target), and when the research has been completed it will add interest in stages in accordance with the degree of success, with treasury investment interest rate (5.2 percent as of 28 March) as the upper limit. In the event that it fails, it will be made interest-free, with repayment expected within 10 years after completion of the research.

Posts and Telecommunications

Tokyo PUROMETEUS in Japanese 10 May 87 pp 24-26

[Text] Priority Measures of the Ministry of Posts and Telecommunications as Seen in the FY87 Science And Technology Budget Proposal

Technology Development Planning Division, Communication Policy Bureau, Ministry of Posts and Telecommunications

I. Summary

The science and technology-related budget of the General Account budget corresponds more or less, to the research expenditure of the Radio Research Laboratory. The FY87 budget is 4.037 billion yen, and its major research items and budget amounts are as shown in Table 1. Meanwhile, concerning special accounts, there is a loan from the Industrial Investment Special Account to the Japan Key Technology Center. In addition to making its main work that of providing, in the form of investments or conditional, interest-free loans, risk-money needed for testing and research on key technology done in the private sector, it conducts such business as mediation in joint research between private sector facilities and national testing and research laboratories,commissioned research from the private sector and International Research Cooperation Japan Trust business of inviting researchers from overseas.

The amount of the FY87 budget is as shown in Table 2.

Table 1. Outline of Main Research Items And Budget Amounts For FY87
(unit: 1,000 yen)

Main research item	FY86 budget	FY87 budget
R&D of light-domain frequency band	26,034	10,718
R&D on mobile-land-communications-propagation in the standard micro-wave band	7,155	20,520
R&D of television simultaneous-broadcast system	35,356	13,564
R&D of electromagnetic-environment measuring device and a method of measurement	11,115	7,858
Experimental research on communications satellites	172,495	102,039
R&D on aerial and marine satellite technology	(385,100) 325,329	389,230
R&D on satellite communications technology	8,770	38,285

R&D of multibeam antenna for satellite use	47,464	(105,600) 24,900
Research on special characteristics of radiowave propagation at 40GHz and above	5,491	14,641
R&D on the technology of high-precision measurement of position based on cosmic radio waves (VLBI) [Very Long Baseline Interferometry]	105,356	55,214
Other	3,381,522	3,360,479

(Figures in parentheses are limits to contracts resulting in treasury obligation)

Table 2. Outline of the Japan Key Technology Center FY87 Budget Proposal (Industrial Investment Special Account) (unit: 100 million yen)

		FY87 budget	Remarks	
			FY86	FY85
Business funds	Investment	173	125	20
	Loans	77	57	20
Endowment		0 (0)	23	60
Total		250	205 (Note 1)	100 (Note 2)

(Note 1) Other Japan Development Bank investment of 12 (endowment)

(Note 2) Other Japan Development Bank investment of 30, private-sector investment of 50 (endowment)

Table 3. Projects Promoted by The Japan Key Technology Center's Investment Enterprise (Limited to Telecommunications Field.)

1. Projects Begun in 1985 (Excluding Those Connected to Teletopia.)

Research topic	Company name

Basic research on intelligent communications systems	ATR Communications System Laboratory Inc.
Basic research on automatic-translation telephone	ATR Automatic-Translation Telephone Laboratory Inc.
Human-science research on audio and visual sense mechanism	ATR Audio Visual Sense Laboratory Inc.
Basic research on photoelectric wave communications	ATR Photoelectric Wave Communications Lab Inc.
R&D on key research for constructing a joint backup communications network	Callnet Inc.
R&D on an associative information storage communications system for which input and output are possible by voice using a personal computer	Japan Database Network Laboratory Inc.
Development of an intra-building integrated data-communication system	Future Building R&D Inc.

2. Projects Begun in FY86 (Excluding Those Connected to Teletopia.)

Research topic	Company name
R&D of telematic library system	Telematic International Laboratory Inc
R&D of conditional access technology	Conditional Access Technology Laboratory Inc.
R&D of stationary-platform-type-communications/broadcast-satellite technology	Space Communication Basic Technology Laboratory Inc.
R&D on high-speed processing architecture for use in a digital, moving-image communications system	Graphic Communication Technologies Inc.

II. The Radio Research Laboratory's Principal Research for FY87

The mainstays of the research in which this laboratory is currently engaged are the five fields of (1) integrated-telecommunications research (2) space-communications research, (3) space-science, atmospheric science research, (4) research on measurement of radio waves and (5) research on standards regarding radio waves.

1. Integrated-Telecommunications Research

We are conducting telecommunications research from an integrated standpoint, aiming toward realization of a telecommunications system by which necessary information can be transmitted swiftly at any time, at any place, and with anyone, which is the ultimate objective of communication. Things such as the following can be given as concrete research items for FY87.

(1) R&D of the light-range frequency band

(2) Research on the propagation of mobile land communications in the standard micro-wave band

(3) R&D of a television simultaneous-broadcast system

(4) R&D of an electromagnetic-environment-measuring device and related methodology.

2. Space Communications Research

The Radio Research Laboratory began early on research on artificial satellites and communications technology which uses satellites, and has grappled with it energetically up to today. Lately it has been carrying on such things as research on satellite-communications utilization technology which is appropriate to an age of multifarious space communications, research and development of mobile-object satellite communications systems for small vessels, aircraft and so on and research and development on such things as inter-satellite communications and large-antenna assembly technology in order to deal with intensification and diversification of satellite communications demand. Things such as the following can be given as concrete research projects for FY87.

(1) Experimental research on communications satellites

(2) R&D on airborne and marine satellite technology

(3) R&D on satellite-communication technology

(4) R&D on a multibeam antenna for satellite use

3. Space Science and Atmospheric Science Research

In addition to observing conditions on the surface of the sun and the earth's periphery, elucidation of the propagation phenomena of radio waves centered on the short-wave band and the prediction of its disturbances, using the data of observation satellites and so on we are carrying out the elucidation of such things as the ionosphere which lies between the sun and the earth. Furthermore, we have also taken part in the polar observation project, and are also actively conducting observation and research on such electromagnetic phenomena which occur in polar regions as the aurora. As one link in this space science/atmosphere science research, in order to develop a new frequency

band, in FY87 we are carrying out research on propagation of radiowaves of 40GHz or above, future use of which is anticipated.

4. Radiowave-Measurement Research

Regarding radiowave research, we are carrying out remote sensing research. Recently we have been pushing ahead with such things as the an image-radar (SI-B) [synthetic aperture imaging radar] experiment using the space shuttle and research on observation of oil pollution on the ocean surface by means of microwave image radar carried in aircraft. Furthermore, research on very long baseline interferometry (VLBI), which makes it possible to measure the distance to remote points on a global scale with a precision of a few centimeters, is also one of the research projects of this field. This VLBI is the newest technology, which becomes possible only upon the integration and development of the Radio Research Laboratory's potential in space communications, radiowave propagation, frequency standard, and data processing. Continuing on in FY87, along with continuing these experiments we are scheduled to push forward also with a joint Japanese-Chinese VLBI experiment.

5. Research on Standards Concerning Radiowaves

We are carrying out primary-frequency-standard research for the purpose of establishing Japan Standard Time by maintaining of high-precision frequencies and times through development of a cesium atomic frequency standard device. Furthermore, due to the fact that it is also necessary to compare times and frequencies between nations and set clocks throughout the world, we are also carrying out research on a system using global positioning satellites (GPS) and meteorological satellites (GMS), and high-precision international and domestic time comparison by means of VLBI technology.

III. Private Sector S&T Through the Japan Key Tech Center's Loans and Funding

The Ministry of Posts and Telecommunications is helping to see that basic, leading-edge research activities in the private sector in the field of telecommunications will be promoted smoothly and actively through loans and funding from the center. The main R&D projects in the telecommunications field which are being promoted as funded enterprises are shown in Table 3. Furthermore, in regard to loans, a great number have been promoted in the telecommunications field alone, with 26 projects which began in FY85 and 18 which began in FY86; looking at the content as well, they cover various topics such as wireless and satellite communications, transmission, image communications and networks, but we shall omit details of the content.

Ministry of Construction

Tokyo PUROMETEUS-in Japanese 10 May 87 pp 26-28

[Text] At present, against the background of rapidly developing technological innovation, Japan's economy and society have begun to change greatly as we approach the 21st century, with urbanization, computerization, aging, and internationalization.

In the improvement of housing and social capital as well, such things as the addition of advanced functions and change to high quality centered on qualitative enhancement of living environment and safety, or the creation of new activity-space are being sought, so it is considered necessary to realize these things in an efficient and economical manner. In addition, with the continuing internationalization of the construction market, it is hoped that we will not only enjoy the fruits of technological innovation, but will, as an advanced nation, go on contributing to the development of construction technology.

This being the case, in the Ministry of Construction's Public Works Research Institute, Building Research Institute, and Geographical Survey Institute, in addition to basic and applied research concerning construction technology focusing on such things as research for the purpose of enhancing the quality of society and life, and for the purpose of enlivening the economy, we are carrying out that research and development which the nation itself should do independently, such as research concerning the devising of various kinds of technical criteria and standards which are required in the advancement of construction administration.

Moreover, because research interchanges which transcend the framework of existing research and development organizations is indispensable, in its implementation we make it a practice to actively encourage joint research with private-sector enterprises.

As shown in the attached table, the construction-technology R&D related budget in FY87 is 5.42 billion yen, a 1-percent increase over the previous fiscal year.

Attached Table: Summary of the construction-technology-R&D-Related Budget

(Unit: 1,000 yen)

Item name	Budget for last FY (A)	FY87 budget (B)	Growth rate (B/A)
1. Expenditure for construction technology R&D	616,638	639,119	1.04
(1) Development of a system for advancing construction technology through use of electronics	90,171	90,443	1.0
(2) Development of technology for enhancing durability of concrete	202,810	195,422	0.96
(3) Development of a new drainage treatment system which makes use of biotechnology	130,128	155,270	1.19
(4) Creation of ocean-utilization space, development of maintenance technology	17,252	64,587	3.74

[continued]

[Continuation of Attached Table]

(5) Development of new technology for wooden architecture	29,148	71,338	2.45
(6) Development of technology for using underground space	--	20,742	--
(7) Development of disaster-information system	--	21,108	--
(8) Development of technology for enhancing dwelling environment in a long-lived society	--	20,209	--
(Completed) Development of integrated water-management technology for lakes and swamps	41,714	--	--
Development of fire-prevention design methods for buildings	68,695	--	--
Development of comprehensive technology concerning building of cities which are impervious to snow	36,720	--	--
2. Expenditure for evaluation of construction technology	13,177	13,177	1.0
3. Expenditure for government-private-sector solidarity joint research	29,647	55,283	1.86
4. Expenditure on testing and research facilities	4,405,804	4,441,609	1.01
(1) Public Works Research Institute expenditure	2,603,568	2,640,561	1.01
(2) Building Research Institute expenditure	1,802,236	1,801,048	1.00
(Subtotal)	5,065,266	5,149,188	1.02
5. Expenditure related to other agencies of government	(182,568) 344,311	(170,433)	(0.93)
(1) Expenditure for coordinating promotion of science and technology (Science and Technology Agency)	161,743	undecided	--
(2) Expenditure for national facilities for atomic energy testing and research (Science and Technology Agency)	38,654	39,903	1.03

[continued]

[Continuation of Attached Table]

(3) Expenditure for promotion of surveys and research on marine development (Science and Technology Agency)	8,606	8,988	1.04
(4) Expenditure for national facility testing and research on pollution prevention etc. (Environment Agency)	135,308	121,542	0.90
6. Other	95,367	96,265	1.01
(1) Expenditure for such things as research for use in experiments connected with the Geographical Survey Institute at Tsukuba	30,470	30,470	1.00
(2) International Research Fair Investigation and Development Plan	40,310	42,373	1.05
(3) Expenditure for work of developing overseas construction technology	24,587	23,422	0.95
(Subtotal)	(277,935) 439,678	(266,698)	(0.96)
Total	(5,343,201) 5,504,944	(5,415,866)	(1.01)

Parentheses indicate calculation which excludes expenditure for coordinating promotion of science and technology.

As comprehensive technology development projects, along with continuing to promote five ongoing tasks, we have decided to begin "development of underground-space-utilization technology," "development of disaster-information systems" and "development of technology for enhancing the dwelling-environment in a long-lived society" in place of three research projects which were finished in the previous fiscal year.

For the government-private-sector joint-research relationship which began in FY86, in addition to continuing to promote "development of an information system between road and vehicle" and "development of technology for supplementing and repairing facing materials," we will start "development of systems for optimizing indoor environments" and "development of systems for inspection and supplementing of existing structures" and we are scheduled to begin joint research after we have recruited partners. In the Public Works Research Institute, in addition to continuing the implementation of such things as "research concerning the special engineering qualities of new materials using 'geotextile'" and "research concerning development of snowfall observation radar," along with beginning "research concerning bottom sediment

movement on beaches and offshore," we will promote development of sea-area control structures by setting up "irregular surface wave-generation equipment." Furthermore, as international joint research, we will continue to promote "joint research concerning the earthquake resistant characteristics of lifeline facilities," as well as "research concerning improved engineering methods for low-flatland rivers" with the Republic of Indonesia.

In the Building Research Institute, in addition to continuing the implementation of such things as "research regarding the aseismic characteristics of structures of high-rise rigid-frame reinforced concrete construction" and "improvement of image data systems," etc., we will begin "research on leading-edge technology to create office space in the 21st century." Moreover, as international joint research, in addition to implementing "Japanese-U.S. joint large aseismic experimental research" using actual structures, we will conduct training in the fields of seismology and seismic engineering for overseas technicians.

In the Geographical Survey Institute, based on the "International Resource Fair Investigation Development Plan," in addition to promoting an increase in accuracy and efficiency of geodetic surveys by means of such things as VLBI, reducing the size and weight of multi-wavelength laser distance-measuring equipment, and study of three-dimensional position determination systems using GPS, we will begin "research concerning the effect of automatic editing on map expression," and will strive for greater sophistication in the processing and display of map data.

Ministry of Transport

Tokyo PUROMETEUS in Japanese 10 May 87 pp 28, 29

[Text] Ministry of Transport Priority Measures as Seen in the FY87 Budget Proposal

Safety Division, Transport Policy Bureau, Ministry of Transport

I. Introduction

Transportation technology covers a broad range, including things as railways, automobiles, vessels, harbors, aviation, waterways, and weather conditions. Also, due to its public character, it receives a broad range of social demands for efficiency of operation, greater convenience, lowered costs for construction of facilities, energy conservation, safety, and prevention of public nuisances. In addition, such demands are becoming more advanced and more diverse, hand in hand with changes in the economic and social environment and in the public's consciousness and sense of values. In this ministry, in FY87 we are making it a practice to actively promote development of technology in response to this kind of social demand.

An outline of the research which the Ministry of Transport will conduct in FY87 is as follows.

II. Overall R&D

We will carry out two projects using transportation technology R&D expenditures and aimed at the promotion of research covering many areas and involving the cooperation of industry, academia, and government. One area is research concerning the lowering of subway costs. An attempt to reduce costs will be made by using linear motors to reduce the size of subway cars, and by making the cross section of the tunnel smaller. In the current fiscal year we will conduct tests on such things as durability of the cars and reliability of signal and public safety systems by running tests on an experimental line. The other area is research to develop technology to build marine structures in deep-water regions offshore, which results from the increased necessity for places to utilize the ocean offshore. In the current fiscal year we will conduct such things as experiments in actual ocean areas concerning floating marine structures and indoor experiments concerning bottom-anchored marine structures.

III. Research at the Main Research Facilities

Looking at it by field, transportation safety research concerns the handling stability of drawn vehicles in order to enhance the safety of connected vehicles such as trailers, research to prevent accidents when large ocean structures are moved at sea, and research concerning enhancement prevention of aircraft collisions in order to deal with the increasing density of air transport. In addition to beginning the above projects in the current fiscal year, we will continue to conduct development of land, sea, and air traffic safety technologies, beginning with research to develop navigation-assistance technology using the model V technology-test satellite (ETS-V) which will be launched in the current fiscal year.

In relation to vessels, harbors, airport construction and ocean development, in addition to beginning research to develop technology to control seawater by means of harbor-related facilities, and to develop technology for creating marine environments in accordance with sea utilization objectives, we will continue to conduct research to establish technology for design and construction of ocean structures by the steel/concrete hybrid method, research regarding ships which can navigate icy waters, and underwater survey robots and research to do such things as elucidate the mechanism of the Kuroshio current.

In relation to natural-disaster countermeasures, in addition to beginning research for the purpose of introducing the cloud-radiation process--which plays a large role in climate fluctuations--into the climate model, we will continue to conduct research for the purpose of practical development of prediction of earthquakes directly below [urban areas].

In relation to atomic energy, we will begin research to ensure safety for large-volume ship-transport of low-level radioactive waste within Japan, and research for the purpose of safe design and inspection of covers in regard to facilities which handle radioactivity in all kinds of forms. Also, we will continue to conduct research concerning such things as safe transport of radioactive matter, atomic-powered vessels, and proliferation of radioactive matter.

In relation to pollution prevention, to deal with the change to larger automobiles, we will initiate research to reduce roadside noise by improving the special characteristics of noise radiation from large automobiles, and research on the exchange of carbon dioxide between the atmosphere and the oceans in wide areas to help evaluate the impact on environmental pollution from carbon dioxide on a global scale, we will continue research on automobile-exhaust countermeasures, ocean pollution countermeasures, FRP [fiber-reinforced plastic], ship waste treatment and dredge-treatment of dirt and mud.

In space development, in addition to the aforementioned experiments using the navigational assistance satellite, we shall continue to conduct research concerning development of the number four geostationary weather satellite, a survey concerning the 2d-generation geostationary weather satellite, and data utilization of microwave and infrared sensors.

In addition, in April of this year the development of railroad technology beginning with development of the superconductor magnetic floating type railroad will be handed over to the Railway Comprehensive Technology Research Foundation, and the Ministry of Transport has also decided to continue to assist the promotion of research subsidies.

Table Summarizing FY87 Ministry of Transport Expenditure for promotion of Science and Technology

(Unit: 1,000 yen)

		17 運輸省所管			21 科学技術庁所管						24 環境庁所管			26 総計		
		昭和61年度	昭和62年度	増減率	22 原子力関係		増減率	25 宇宙開発関係		増減率	2 公害防止関係		増減率	昭和61年度	昭和62年度	増減率
		18 予算額	19 予算案額	20 (%)	61年予算額	62年予算案	20 (%)	61年予算額	62年予算案	20 (%)	61年予算額	62年予算案	20 (%)	18 予算額	19 予算案額	20 (%)
1	1.試験研究機関経費															
2	(1)船舶技術研究所	2.439.854	2.488.690	2.0	108.046	107.785	△ 0.2				73,963	47.454	△35.8	2.621.863	2.643.639	0.8
3	(2)電子航法研究所	475.147	425.002	△10.6										475.147	425.002	△10.6
4	(3)港湾技術研究所	1.491.309	1.574.574	5.6							31.145	31.258	0.4	1.522.454	1.605.832	5.5
5	(4)交通安全公害研究所	532.790	544.098	2.1							70.364	70.114	△ 0.4	603.154	614.212	1.8
6	(5)気象研究所	2.228.506	2.219.727	△ 0.4	36.711	48.557	32.3	10.646	12.455	17.0	21.343	33.271	55.9	2 297.206	2.314.010	0.7
7	小計	7.167.606	7.252.001	1.2	144.757	156.342	8.0	10.646	12.455	17.0	196.815	182.097	△ 7.5	7.519.824	7.602.895	1.1
8	2.行政部門経費															
9	(1)運輸技術の研究開発	145.299	134.318	△ 7.6										145.299	134.318	△ 7.6
10	(2)海技大学校				6.112	6.206	1.5							6.112	6.206	1.5
11	(3)海上保安庁				84.457	63.894	△24.3	56.761	51.896	△ 8.6	15.219	16.424	7.9	156.437	132.214	△15.5
12	(4)気象庁															
13	ア.静止気象衛星業務	4.196.489	5.372.068	28.0										4.196.489	5.372.068	28.0
14	イ.その他				47.027	52.126	10.8	35.716	34.233	△ 4.2				82.743	86.359	4.4
15	小計	4.343.788	5.506.386	26.8	137.596	122.226	△11.2	92.477	86.129	△ 6.9	15.219	16.424	7.9	4.589.080	5.731.165	24.9
16	総計	11.511.394	12.758.387	10.8	282.353	278.568	△ 1.3	103.123	98.584	△ 4.4	212.034	198.521	△ 6.4	12.108.904	13.334.060	10.1

Key:
1. Testing and research facility expenditure
2. Ship Research Institute
3. Electronic Navigation Research Institute
4. Port and Harbor Research Institute
5. Traffic Safety and Nuisance Research Institute
6. Meteorological Research Institute
7. Subtotal

8. Administrative department expenditure
9. Transport-technology R&D expenditure
10. Maritime Technical Academy [misprint?]
11. Maritime Safety Agency [misprint]
12. Meteorological Agency
13. Stationary weather satellite work
14. Other
15. Subtotal
16. Grand total
17. Under jurisdiction of Ministry of Transport
18. FY86 budget amount
19. FY87 budget amount
20. Rate of increase or decrease (percent)
21. Under the jurisdiction of the Science and Technology Agency
22. Atomic-energy related
23. Marine-development related
24. Under the jurisdiction of the Environment Agency
25. Pollution-prevention related
26. Grand total
27. *Subsidy for expenditure for development of railway technology (such things as subsidy for development of technology for the superconductor-magnetic floating formula railway) 481,256 (unit is 1,000 yen)

IV. Postscript

In the foregoing we have introduced the main technological developments to be conducted in FY87. In the Ministry of Transport we will also make it a practice to promote various kinds of research and development other than these in response to diverse administration demands.

Science and Technology Agency

Tokyo PUROMETEUS in Japanese 10 May 87 pp 30-35

[Text] FY87: Summary of the Science and Technology Agency's Major Measures

General Affairs Division, Director General's Secretariat, Science and Technology Agency

We shall present a summary of the Science and Technology Agency's FY87 major measures.

In the government, the Outline of Science and Technology Policy, which determined the basis of present science and technology policy, was decided on by the cabinet in March of last year, and at the Science and Technology Agency, we make it a policy to actively tackle the promotion of science and technology in accordance with the general principles indicated therein.

First there is the budget: the total amount of the FY87 Science and Technology Agency budget is 432.5 billion yen, an increase of 4.8 billion yen over the 427.8-billion yen initial budget amount for the previous fiscal year, a growth rate of 1.1 percent. It breaks down into 333.7 billion yen from the

General Account, 4.3 billion yen from the Industrial Investment Special Account and 94.6 billion yen from the Account for Electric Power Source Development and Promotion Measures.

Next we shall present its main measures by item.

(Figures in parentheses represent FY86 budget amounts.)

1. Overall Development of Science and Technology Administration:
8.5 (7.9) Billion Yen

We will strive for expansion of science and technology, promotion and coordination expenditures, which are used in keeping the policy of the Council for Science and Technology. Along with promoting studies relating to the Human Frontier Science Program, which are also based on the viewpoint of contributing to international society, we will attempt promotion of international research interchanges and a flexible response toward commissioned research.

2. Expansion and Strengthening of Creative Basic Research and Its International Development: 4.7 (3.8) Billion Yen

We will attempt to expand international frontier research, which conducts leading-edge basic research aimed at 21st century technological innovation, in a long-term manner under a system which is opened internationally. Furthermore, concerning the system to promote creative science and technology, we will strive for its expansion by such things as setting to work on three new tasks.

3. Improvement of the Foundation for Research and Development:
9.4 (8.6) Billion Yen

We will conduct investigations and research concerning a high-performance radiant-light facility, in hopes that it will bring rapid results in basic research of a broad range of fields.

Moreover, we will operate the Research Interchange Promotion Law smoothly, and further promote such research interchange of industry, academia, government, and so on as joint research with the private sector.

In addition, we will continue expansion of all kinds of databases and building of international science and technology information networks in order to strive for efficient circulation of science and technology data.

Furthermore, we shall promote gene-bank projects in order to strengthen the system for collection, preservation and supply of gene resources, which are indispensable to the promotion of research and development.

4. Promotion of International Cooperation in Science and Technology: 29.7 (33.3) Billion Yen

With the importance of international interchanges becoming greater, along with actively participating in international cooperation projects, we will attempt to promote international cooperation by placing special emphasis on joint research and interchange of talented persons, engaging in cooperation with the advanced countries of Europe and America in a wide range of fields and cooperation with such developing nations as the nations of ASEAN.

5. Promotion of Research, Development, and Utilization of Atomic Power, and of Safety Measures: 273.4 (275.2) Billion Yen

To begin with, taking into consideration the accident at the Soviet Chernobyl nuclear facility which occurred in April 1986, along with striving to expand administration of nuclear power safety regulations and the system for investigating environmental radiation, we will make doubly sure of ensuring safety by striving to promote safety research.

Next, in order to strive for smooth promotion of nuclear power generation, the establishment of an independent nuclear-fuel cycle is indispensable, so along with vigorous promotion of uranium enrichment, reprocessing of spent fuel and processing and disposal of radioactive waste, we will promote smooth commercialization by devising measures required for promotion of construction plans for nuclear-fuel cycle facilities in the private sector.

Furthermore, we will actively advance the development of new-model power reactors through construction of the prototype fast breeder-reactor "Monju" and promotion of the plan for the new-model converter-demonstration reactor.

Concerning nuclear fusion, which is said to be mankind's ultimate energy source, aiming for the achievement of critical plasma conditions at the end of FY87, we will continue experiments with the critical plasma testing device "JT-60," and will continue to advance research and development concerning nuclear-powered ships as well.

In addition, we will advance design-research for a high-temperature-engineering testing and research reactor and research on advanced utilization of radiation.

Furthermore, by devising measures to enhance the welfare of residents of area in which atomic-power facilities are situated, and promotion of the areas through the three laws on electricity sources, we will attempt to support research, development, and utilization of atomic power while gaining the understanding and cooperation of the public.

6. Promotion of the Development of Space: 94.6 (92.6) billion yen

We will actively promote development of space, making independent research and development the keynote, while striving for harmony with international activities.

To begin with, we will participate fully in the space station plan which is being advanced jointly by Japan, America, Europe, and Canada, and will begin development of Japan's experimental module.

Furthermore, in addition to the development of artificial satellites in communications, broadcasting, observation, and various common technology areas, along with beginning development of the model IV technology testing satellite, we will conduct research on the marine observation satellite 1-b.

In addition, we will continue to support development of the H-II rocket, which has the capacity to launch a geostationary satellite of the 2-ton class.

7. Promotion of Marine Development: 7.7 (6.6) Billion Yen

For the maritime nation of Japan, it is necessary to actively promote research and development on maritime science and technology.

For this reason, along with continuing to promote construction of a 6,000-meter class diving survey ship, which is indispensable for such things as research on ocean-floor mineral resources and earthquake prediction, we will begin work on construction of its support mother ship. Moreover, we will actively promote such integrated marine-science-and-technology projects as research and development of diving-work technology using an undersea-work experiment ship.

8. Promotion of Life Science: 11.9 (9.5) Billion Yen

Concerning measures connected with life science, which contribute to human welfare in a broad range of fields, we will vigorously promote such things as cancer-related research and research on aging, focusing on human-system science and technology.

9. Promotion of R&D on Matter Materials Science and Technology: 9.4 (9.2) Billion Yen

Concerning matter and materials science and technology, which are important basic technologies in terms of advancing various kinds of technological development, we will promote leading-edge research and development, including research on high-performance-function materials such as superconducting materials.

10. Promotion of Earth Science and Technology: 18.2 (18.9) Billion Yen

Along with promoting such things as research and development of earth-observation technology, we will strive to promote disaster-prevention science and technology centered on such things as earthquake prediction, earthquake-damage countermeasures, prediction of volcanic eruptions and countermeasures against snow damage.

11. Promotion of Other Important Integrated Research: 19 (18.3) Billion Yen

Concerning research and development of aviation technology, along with continuing to advance flight experiments of the fan jet STOL experimental aircraft "Asuka" we will begin research and development of innovative aerospace transport technology.

Moreover, in addition to striving to promote such basic research as laser science and technology research, we will advance such things as measures for the purpose of comprehensive utilization of resources.

Comprehensive Table of FY87 Science and Technology Agency Budget proposal
Director General's Secretariat, Science and Technology Agency

(Unit: 1 million yen)
(*Indicates a contract resulting in treasury obligation)

Classification	Initial budget proposal for FY86	FY87 budget proposal	Increase/ decrease	Compared with FY 86 percent
1. General Account	*123,581 330,482	*139,353 333,674	*15,772 3,192	101.0
2. Industrial Investment Special Account	4,000	4,300	300	107.5
3. Special Account for Electric Power Source Development and Promotion Measures	*45,970 93,272	*82,060 94,552	*36,090 1,280	101.4
(1) Power-source site bill	12,236	12,596	270	102.2
(2) Power-source diversification bill	*45,970 80,946	*82,060 81,956	*36,090 1,010	101.2
Science and Technology Agency total	*169,551 427,754	*221,413 432,526	*51,862 4,772	101.1

Principal Content of the Budget Proposal

Item	FY 87 budget amount A	FY87 budget proposal B	Increase/ decrease B/A
1. Integrated development of science and technology administration	7,949	8,483	534
Note: 106.7 percent			
Of which, expansion of expenditure for promotion and coordination of science and technology is	7,900	8,400	500
Note: 106.7 percent Investigation of international basic research program (Human Frontier Science Program), promotion of international research interchange and commissioned research, etc.			
2. Expansion and strengthening of creative basic research, and its international deployment	*1,012 3,806	* 491 4,693	*-521 887
Note: 123.3 percent			
(1) Expansion of international frontier research system	*1,012 1,119	*491 1,535	*-521 416
Note: Expansion of the two tasks of organism homeostatis and frontier material			
(2) Expansion of system for promoting creative science and technology	2,687	3,158	471
Note: Three new tasks: (photowave data, generation genes, chemical recognition (provisional names)			
3. Improving the foundation for R&D	8,623	9,431	808
Note: 109.4 percent			
(1) Survey and research on radiation facilities	0	69	69
Note: Research on radiation (SOR) [synchrotron orbital radiation] technology: 65			
(2) Promotion of industry-academia-government research interchange, etc.	2,537	2,499	-38

[continued]

[Continuation of Principal Content of the Budget Proposal

Item	FY 87 budget amount A	FY 87 budget proposal B	Increase/ decrease B/A
Note: Government-private-sector joint research: 120 Domestic and overseas in-service training, etc. for public-service research staff, etc. 473 High-tech consortium system: 208 Research Development Corp. of Japan: 1,556 (Total amount including creative science, high tech: 4,922) Ceiling on commissioned development contracts: 5.1 billion yen			
(3) Promotion of circulation of data on science and technology	5,747	6,373	626
[General Account	1,747	2,073	326
Industrial Investment Special Account]	4,000	4,300	300]
Note: The Japan Information Center of Science and Technology (JICST): 6,364 Database expansion 4,012 Online service expansion 2,504 Of which: Development of new online provision system (JOIS-III): 300 Construction of an international science and technology data network: 485 Preparation of machine-translation system 205			
(4) Preparation of a system for collection, preservation, and supply of gene resources, etc.	339	490	151
Note: Preparation and operation of a gene-bank building: 368 Of which: Cell, gene preservation work: 149 Work of preserving and supplying microorganism systems: 102 Devising and investigating resource biopreservation measures, etc.: 20			
4. Promotion of International cooperation in Science and Technology	[*13,193 33,269]	[*43,736 29,719]	[*30,543 -3,550]
[General Account	*13,193	*43,736	*30,543
Industrial Investment Special Account]	32,594	29,383	-3,211
	675	336	-339

[continued]

[Continuation of Principal Content of the Budget Proposal

Item		FY87 budget amount A	FY87 budget proposal B	Increase/ decrease B/A
Note: 89.3 percent (Due to reappropriation from other business):	*42,898			
Cooperation with advanced nations:	23,302			
Cooperation with developing nations:	3,212			
Of which, strengthening of international exchange of talented persons is:		[1,706]	[1,807]	[101]
Note: (Due to reappropriation from other business)				
Exchange of persons with advanced nations:	1,127			
Exchange of persons with developing nations:	383			
5. Promotion of such things as R&D in leading-edge, important fields of science and technology		*169,551 409,253	*221,363 412,553	*51,812 3,300
Note: 100.8 percent				
(1) Promotion of atomic energy R&D, and use as well as safety measures		*74,781 275,171	*118,359 273,363	*43,578 -1,808
Note: 99.3 percent				
(General Account)		*28,811 181,899	*36,299 178,811	*7,488 -3,088
Note: 98.3 percent				
Of which, 1) Expansion and strengthening of atomic energy safety measures and anti-proliferation measures		2,058	1,982	-76
Note: Research on measurement and surveying of radioactivity:	765			
Security measures, nuclear matter protection measures:	594			
Analysis, investigation, etc. of atomic power plant accidents:	51			
2) Japan Atomic Energy Research Institute		*20,618 101,566	*23,129 99,462	*2,511 -2,094

[continued]

[Continuation of Principal Content of the Budget Proposal]

Item		FY87 budget amount A	FY87 budget proposal B	Increase/ decrease B/A
Note: Safety research:	*5,078 9,639			
Nuclear fusion R&D	*974 29,188			
Of which, construction and operation of the JT-60 is:	*974 23,459			
R&D of atomic powered ship is:	*6,157 8,717			
Research on design of high-temperature engineering testing and research reactor is:	500			
Radiation high-tech research is:	*3,432 493			
3) Power Reactor Nuclear Fuel Development Corp. (PNC)		*8,193 65,925	*5,740 64,289	*-2,453 -2,094
Note: (Grand total including Special Account for Electric Power Source Development and Promotion Measures	*87,800 141,553			
Development of power reactor:	*5,740 35,790			
Of which, development of fast breeder reactor:	*4,753 15,367			
Development of new-type conversion reactor:	1,627			
Overseas prospecting for uranium resources:	3,968			
Development of uranium-enrichment technology:	2,263			
4) National Institute of Radiological Sciences		6,462	*3,100 7,085	*3,100 623
Note: Manufacture of heavy particle cancer treatment device, etc.	*3,100 1,565			
5) Testing and research of national testing and research facilities		1,774	1,789	15
Note: Package appropriation for expenditure for atomic energy testing and research for all agencies				

[continued]

[Continuation of Principal Content of the Budget Proposal]

Item		FY87 budget amount A	FY87 budget proposal B	Increase/ decrease B/A
6) Institute of Physical and Chemical Research's atomic energy research		3,469	*4,330 3,549	*4,330 80
Note: Construction and operation of a heavy-ion accelerator	*4,330 3,043			
Development of laser-method uranium-enrichment technology:	381			
(Special Account for Electric Power Source Development and Promotion Measures)		*45,970 93,272	*82,060 94,552	*36,090 1,280
Note: 101.4 percent				
1) Power-source siting bill		12,326	12,596	270
Note: 102.2 percent				
Commissioned expenditure for atomic power electricity generation safety measures, etc.:	5,474			
Subsidy for power-source site promotion:	3,511			
Power-source site special subsidy:	1,364			
Subsidies for atomic power electricity generation safety measures, etc.	2,114			
2) Power-source diversification bill		*45,970 80,946	*82,060 81,956	*36,090 1,010
Note: 101.2 percent				
a) Power-Reactor Nuclear-Fuel Development Corp.		*45,970 76,319	*82,060 77,264	*36,090 945
Note: Construction of fast breeder reactor "Monju":	*70,299 40,459			
R&D on new converter demonstration reactor:	868			
Development of reprocessing:	*2,933 13,109			
Construction of prototype uranium enrichment plant:	*122 6,904			
b) Other		4,627	4,692	65

[continued]

[Continuation of Principal Content of the Budget Proposal]

Item		FY87 budget amount A	FY87 budget proposal B	Increase/ decrease B/A
Note: Commissioned development of nuclear-reactor dismantling technology:	2,003			
Commissioned development of laser-method uranium enrichment technology:	702			
Promotion of radioactive-waste disposal and disposition technology:	536			
(2) Promotion of development of space		*78,469 92,582	*94,190 94,569	*15,721 1,987
Note: 102.1 percent				
1) National Space Development Agency		*78,322 90,659	*94,035 92,648	*15,713 1,989
Note: Development of H-II rocket:	*34,225 30,003			
Research on marine-observation satellite 1-b, etc.:	*1,331 609			
Development of the model-V technology testing satellite:	3,238			
Development of communications satellite No 3:	*22 4,897			
Development of stationary-weather-satellite No 4:	*386 2,155			
Development of broadcast-satellite No 3:	*4,881 2,367			
Development of global-resources satellite No 1:	*5,187 5,418			
Development of technology-testing satellite model VI:	*10,485 2,361			
Development of a primary materials experimental system:	*92 1,355			
Participation in the space-station plan:	*24,024 6,033			
2) Space-science-related research of the National Aerospace Laboratory:		*147 1,395	*155 1,387	*8 -8

[Continuation of Principal Content of the Budget Proposal]

Item		FY87 budget amount A	FY87 budget proposal B	Increase/ decrease B/A
Note: Research on liquid-oxygen, liquid-hydrogen rocket-engine elements for use in the H-II rocket:	*155 367			
(3) Promotion of marine development		*12,500 6,648	*7,135 7,727	*-5,365 1,079
Note: 116.2 percent				
1) Japan Marine Science and Technology Center		*12,500 6,437	*7,135 7,516	*-5,365 1,079
Note: Deep-sea survey and research:	*7,135 4,641			
Of which, Construction of 6,000-m class diving survey ship:	*625 2,518			
Construction of support mothership for same:	*6,510 638			
R&D of diving-work technology:	1,368			
Of which, Operation of undersea-work experiment-ship:	1,032			
2) Other		211	211	0
Note: Survey and research on development and utilization of Kuroshio:	112			
(4) Promotion of life science		[*260 9,511]	[*4,080 11,908]	[*3,820 2,397]
Note: 125.2 percent (due to reappropriation from other items, etc.)				
Of which, Human-system science and technology R&D		[1,622]	[*440 2,016]	[*440 394]
Institute of Physical and Chemical Research:	*980 2,524			
Cancer-related research		[4,360]	[*3,639 5,545]	[*3,639 1,185]

[continued]

[Continuation of Principal Content of the Budget Proposal]

Item		FY87 budget amount A	FY87 budget proposal B	Increase/ decrease B/A
Note: Of which, Frontier research (organism homeostatis):	*440 386			
Research on science and technology of the brain and nervous system, immune system, etc.:	190			
Amount expected to be appropriated from expenditure for promotion and coordination of science and technology:	2,200			
Amount expected for commissioned development of new technology:	1,589			
System for promotion of creative science and technology (other than (creation gene (provisional name)):	1,797			
National Institute of Radiological Sciences:	*3,100 3,257			
Of which, Research on medical uses of heavy-particle beam:	*3,100 1,757			
(5) Promotion of R&D on matter, materials-system science and technology		*2,121 9,227	*231 9,437	*-1,890 210
Note: 102.3 percent (includes reappropriation for other business)				
National Research Institute for Metals:	4,514			
National Institute for Research in Inorganic Materials	*180 2,078			
Expected amount of appropriation from expenditure for promotion and coordination of science and technology:	2,100			
System for promotion of creative science and technology (chemical perception (provisional name)):	101			
Frontier research (Frontier Material):	*51 644			
Promotion of earth-science technology		*29,209 18,914	*14,074 18,232	*-15,135 -682
Note: 96.4 percent				

[continued]

[Continuation of Principal Content of the Budget Proposal]

Item		FY87 budget amount A	FY87 budget proposal B	Increase/ decrease B/A
1) Promotion of R&D on earth-observation technology, etc.		*27,991 16,380	*14,049 15,677	*-13,942 -703
(Due to reappropriation from other business, etc.)				
Research on marine observation satellite 1-b, etc.:	*1,331 609			
Development of earth resource satellite 1:	*5,187 5,418			
Development of stationary weather satellite 4:	*386 2,155			
Earth-observation data processing:	*9 2,542			
Note: National Research Center for Disaster Prevention	*5 2,550			
Of which, Earthquake-prediction research:	881			
Earthquake-disaster-countermeasure research:	*25 522			
Snow-damage-countermeasure research:	102			
(7) Promotion of other important integrated research, etc.		*462 18,336	*1,034 18,988	*572 652
Note: 103.6 percent				
1) National Aerospace Laboratory's aviation-technology-related research		*202 8,619	*494 8,880	*292 261
Note: R&D of fan jet STOL aircraft:	3,101			
R&D of innovative aerospace transport element technology (Grand total including space)	85			
(Grand total for National Aerospace) Laboratory including space:	*649 10,267			
2) Other		*260 9,717	*540 10,108	*280 391

[continued]

[Continuation of Principal Content of the Budget Proposal]

Item		FY87 budget amount A	FY87 budget proposal B	Increase/ decrease B/A
Note: Institute of Physical and Chemical Research	*540 9,608			
Of which, Research on laser science and technology:	217			
Grand total for Institute of Physical and Chemical Research including atomic energy and frontier:	*5,361 14,692			
Promotion of resource integrated utilization policy:	362			
Promotion of science and technology public relations and education activities:	138			

12373/9365
CSO: 4306/3416

END